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(71) Applicant (for AE, AG, AL, AM, AT, AU, AZ, BA, BB, BE, BF, BG, BJ, BR, BW, BY, BZ, CA, CF, CG, CH, CI, CM, CN, CO, CR, CU, CY, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, FR, GA, GB, GD, GE, GH, GM, GN, GQ, GR, GW, HR, HU, ID, IE, IL, IN, IS, IT, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MC, MD, MK, ML, MN, MR, MW, MX, MZ, NA, NE, NG, NI, NL, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD only): **ASTRAZENECA AB** [SE/SE]; S-SE-151 85 Södertälje (SE).

(71) Applicant (for MG only): **ASTRAZENECA UK LIMITED** [GB/GB]; 15 Stanhope Gate, London Greater London W1K 1LN (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BONNERT, Roger, Victor** [GB/GB]; AstraZeneca R & D Charnwood,

Bakewell Road, Loughborough Leicestershire LE11 5RH (GB). **ALCARAZ, Lilian** [FR/GB]; AstraZeneca R & D Charnwood, Bakewell Road, Loughborough Leicestershire LE11 5RH (GB). **MOHAMMED, Rukhsana, Tasneem** [GB/GB]; AstraZeneca R & D Charnwood, Bakewell Road, Loughborough Leicestershire LE11 5RH (GB). **COOK, Anthony, Ronald** [GB/GB]; AstraZeneca R & D Charnwood, Bakewell Road, Loughborough Leicestershire LE11 5RH (GB). **THOM, Stephen** [GB/GB]; AstraZeneca R & D Charnwood, Bakewell Road, Loughborough Leicestershire LE11 5RH (GB). **LUKER, Timothy, Jon** [GB/GB]; AstraZeneca R & D Charnwood, Bakewell Road, Loughborough Leicestershire LE11 5RH (GB).

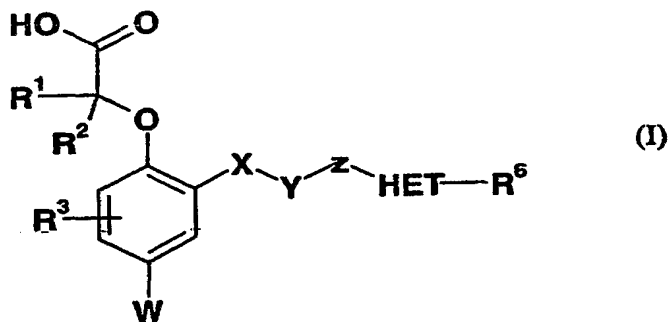
(74) Agent: **GLOBAL INTELLECTUAL PROPERTY**; AstraZeneca AB, S-SE-151 85 Södertälje (SE).

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[Continued on next page]

(54) Title: PHENOXYACETIC ACID DERIVATIVES USEFUL FOR TREATING RESPIRATORY DISEASES



(57) Abstract: The invention relates to substituted phenoxyacetic acids as useful pharmaceutical compounds for treating respiratory disorders, pharmaceutical compositions containing them, and processes for their preparation. Formula (I)

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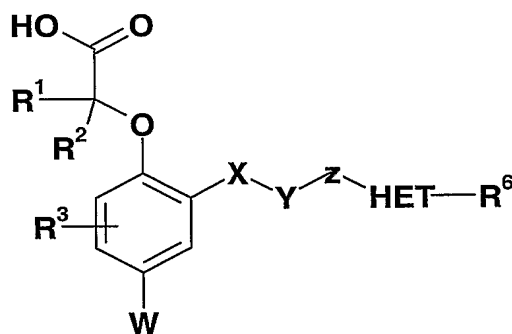
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# PHENOXYACETIC ACID DERIVATIVES USEFUL FOR TREATING RESPIRATORY DISEASES

The present invention relates to substituted phenoxyacetic acids as useful pharmaceutical compounds for treating respiratory disorders, pharmaceutical compositions containing them, and processes for their preparation.

5 EPA 1 170 594 discloses methods for the identification of compounds useful for the treatment of disease states mediated by prostaglandin D2, a ligand for orphan receptor CRTH2. GB 1356834 discloses a series of compounds said to possess anti-inflammatory, analgesic and antipyretic activity. It has been found that certain phenoxyacetic acids are active at the CRTH2 receptor, and as a consequence are expected to be potentially useful for  
10 the treatment of various respiratory diseases, including asthma and COPD.

In a first aspect the invention therefore provides a compound of formula (I) or a pharmaceutically acceptable salt thereof:



(I)

in which:

$R^1$  and  $R^2$  independently represent a hydrogen atom, halogen,  $C_2$ - $C_6$  alkenyl,  $C_2$ - $C_6$  alkynyl,  $C_3$ - $C_7$  cycloalkyl or a  $C_{1-6}$  alkyl group, the latter four groups being optionally substituted by one or more substituents independently selected from halogen,  $C_3$ - $C_7$   
20 cycloalkyl,  $NR^9R^{10}$ ,  $OR^8$ ,  $S(O)_nR^7$  (where n is 0, 1 or 2);

or

$R^1$  and  $R^2$  together can form a 3-8 membered ring optionally containing one or more atoms selected from O, S,  $NR^{11}$  and itself optionally substituted by one or more  $C_1$ - $C_3$  alkyl or halogen;

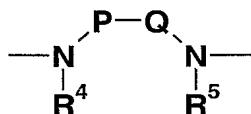
25 W is halogen, cyano, nitro,  $SO_2R^7$ ,  $SO_2NR^9R^{10}$ ,  $OR^8$ , or  $C_{1-6}$  alkyl, the latter being optionally substituted by one or more substituents independently selected from halogen,  $OR^8$  and  $NR^7R^8$ ,  $S(O)_nR^5$  where n is 0, 1 or 2.

$R^3$  is one or more substituents independently selected from hydrogen, halogen, CN, nitro,  $SO_2R^7$ ,  $OR^8$ ,  $SR^7$ ,  $SOR^7$ ,  $SO_2NR^9R^{10}$ ,  $CONR^9R^{10}$ ,  $NR^9R^{10}$ ,  $NR^{11}SO_2R^7$ ,  $NR^{11}CO_2R^7$ ,  $NR^{11}COR^7$  or  $C_{1-6}$ alkyl, the latter being optionally substituted by one or more substituents independently selected from halogen,  $OR^8$  and  $NR^9R^{10}$ ,  $S(O)_nR^7$  where n is 0, 1 or 2;

5 X represents a bond, or  $C_1$ - $C_6$  alkyl, optionally substituted by one or more substituents independently selected from halogen,  $C_1$ - $C_6$  alkyl the latter being optionally substituted by one or more substituents independently selected from halogen,  $OR^6$  and  $NR^7R^8$ ,  $S(O)_nR^5$  where n is 0, 1 or 2;

Y represents a diamine of the following type:-

10



$R^4$  and  $R^5$  independently represent hydrogen,  $SO_2R^7$ ,  $C(O)R^7$ ,  $CO_2R^7$  and  $C_1$ - $C_6$  alkyl, the latter being optionally substituted by one or more substituents independently selected from aryl, heteroaryl, halogen,  $OR^8$  and  $NR^9R^{10}$ ,  $S(O)_nR^7$  where n is 0, 1 or 2;

15  $R^4$  and  $R^5$  are joined together or one of  $R^4$  and  $R^5$  is joined onto P or Q to form a saturated heterocyclic 3-10 membered ring with, 1 or 2 endocyclic nitrogen atoms;

P and Q independently represent,  $C_1$ - $C_6$  alkyl optionally substituted by one or more substituents independently selected from (=O), halogen,  $OR^8$  and  $NR^9R^{10}$ ,  $S(O)_nR^7$  (where n is 0, 1 or 2),  $C_1$ - $C_6$  alkyl,  $C_3$ - $C_6$  cycloalkyl, aryl or heteroaryl (the latter two being optionally substituted by one or more substituents independently selected from halogen,  $OR^8$  and  $NR^9R^{10}$ ,  $CONR^9R^{10}$ ,  $S(O)_nR^7$  where n is 0, 1 or 2);

20 Z represents a bond,  $(CR^{12})_n-C(O)$ ,  $(CR^{12})_n-S(O)_n$ ,  $C(O)(CR^{12})_n$ , or  $S(O)_2(CR^{12})_n$ ,  $S(O)_2N(CR^{12})_n$ , where n= 0, 1 or 2;.

HET represents aryl or heteroaryl;

25  $R^6$  represents one or more substituents independently selected from hydrogen, halogen, CN, nitro,  $COR^7$ ,  $CO_2R^8$ ,  $SO_2R^7$ ,  $OR^8$ ,  $SR^8$ ,  $SOR^7$ ,  $SO_2NR^9R^{10}$ ,  $CONR^9R^{10}$ ,  $NR^9R^{10}$ ,  $NR^8SO_2R^7$ ,  $NR^8CO_2R^8$ ,  $NR^8COR^7$ ,  $NR^8CONR^9R^{10}$ ,  $NR^8SO_2NR^9R^{10}$ , aryl, heteroaryl,  $C_2$ - $C_6$  alkenyl,  $C_2$ - $C_6$  alkynyl,  $C_3$ - $C_7$  cycloalkyl or  $C_{1-6}$ alkyl, the latter four groups being optionally substituted by one or more substituents independently selected from halogen,  $C_3$ - $C_7$  cycloalkyl, CN,  $OR^8$ ,  $NR^9R^{10}$ ,  $S(O)_nR^7$  (where n is 0, 1 or 2),  $CONR^9R^{10}$ ,  $NR^8COR^7$ ,  $SO_2NR^9R^{10}$  and  $NR^8SO_2R^7$ ;

30

$R^7$  represents a  $C_1$ - $C_6$  alkyl, an aryl or a heteroaryl group all of which may be optionally substituted by halogen atoms,  $OR^8$ ,  $NR^{14}R^{15}$ ;

$R^8$  represents hydrogen,  $C_1$ - $C_6$ , alkyl, an aryl or a heteroaryl group all of which may be optionally substituted by halogen atoms,  $OR^8$ ,  $NR^{14}R^{15}$ ;

5  $R^9$  and  $R^{10}$  independently represent hydrogen,  $C_3$ - $C_7$  cycloalkyl or  $C_{1-6}$ alkyl, the latter two groups being optionally substituted by one or more substituents independently selected from halogen,  $C_3$ - $C_7$  cycloalkyl,  $OR^6$  and  $NR^{14}R^{15}$ ,  $S(O)_nR^6$  (where  $n = 0, 1$  or  $2$ ),  $CONR^7R^8$ ,  $NR^6COR^7$ ,  $SO_2NR^7R^8$  and  $NR^6SO_2R^5$ ;

or

10  $R^9$  and  $R^{10}$  together with the nitrogen atom to which they are attached can form a 3-8 membered saturated heterocyclic ring optionally containing one or more atoms selected from O,  $S(O)_n$  (where  $n = 0, 1$  or  $2$ ),  $NR^{13}$ , and itself optionally substituted by halogen or  $C_{1-3}$  alkyl;

$R^{11}$  represents a hydrogen atom,  $C(O)R^9$ ,  $C_1$ - $C_6$  alkyl an aryl or a heteroaryl group (the latter three can be optionally substituted by halogen);

15  $R^{12}$  represents one or more from hydrogen, or a  $C_{1-6}$ alkyl group, the latter being optionally substituted by one or more substituents independently selected from halogen,  $C_3$ - $C_7$  cycloalkyl,  $NR^{14}R^{15}$ ,  $OR^8$ ,  $S(O)_nR^7$  (where  $n$  is 0, 1 or 2);

$R^{13}$  represent hydrogen,  $C_{1-4}$  alkyl,  $-COC_{1-4}$  alkyl,  $COYC_{1-4}$ alkyl where Y is O or  $NR^7$ ; and

20  $R^{14}$  and  $R^{15}$  independently represent hydrogen,  $C_{1-4}$  alkyl

or

$R^{14}$  and  $R^{15}$  together with the nitrogen atom to which they are attached can form a 3-8 membered saturated heterocyclic ring optionally containing one or more atoms selected from O,  $S(O)_n$  (where  $n = 0, 1$  or  $2$ ),  $NR^{13}$ , and itself optionally substituted by halogen or  $C_{1-3}$  alkyl.

25 Examples of monocyclic saturated rings as defined for Y include piperizine, alkyl substituted piperizine (such as methyl, ethyl or propyl piperizine), piperazinone, imidazolidine, homopiperazine, aminopyrrolidine, aminoazetidine and aminopiperidine.

Examples of aryl include phenyl and naphthyl.

Heteroaryl is defined as a 5-7 member aromatic ring or can be 6,6- or 6,5-fused bicyclic  
30 ring optionally containing one or more heteroatoms selected from N, S and O. The bicyclic ring may be linked through carbon or nitrogen and may be attached through the 5 or 6 membered ring and can be fully or partially saturated. Examples include pyridine, pyrimidine, thiazole, oxazole, pyrazole, imidazole, furan, isoxazole, pyrrole, isothiazole and

azulene, naphthyl, indene, quinoline, isoquinoline, indole, indolizine, benzo[b]furan, benzo[b]thiophene, 1H-indazole, benzimidazole, benzthiazole, benzoxazole, purine, 4H-quinolizine, cinnoline, phthalazine, quinazoline, quinoxaline, 1,8-naphthyridine, pteridine, quinolone and 1,2-methylenedioxy benzene.

5 In the context of the present specification, unless otherwise indicated the groups aryl and heteroaryl can be optionally substituted by R<sup>6</sup>.

In the context of the present specification, unless otherwise indicated, an alkyl or alkenyl group or an alkyl or alkenyl moiety in a substituent group may be linear or branched.

10 Heterocyclic rings as defined for R<sup>14</sup> and R<sup>15</sup> means saturated heterocycles, examples include morpholine, thiomorpholine, azetidine, imidazolidine, pyrrolidine, piperidine and piperazine.

Preferably W is halogen, CF<sub>3</sub>, CN or C<sub>1</sub>-C<sub>6</sub>alkyl; more preferably W is halogen, methyl, CN or CF<sub>3</sub>;

Preferably R<sup>1</sup> and R<sup>2</sup> are independently hydrogen or methyl.

15 Preferably R<sup>3</sup> is hydrogen or halogen, more preferably R<sup>3</sup> is hydrogen;

Preferably X is a bond or CH<sub>2</sub>, more preferably X is CH<sub>2</sub>;

Preferably the group Y (together with the two nitrogen atoms to which it is attached) is piperazine, piperazinone, homopiperazine or amino pyrrolidine; more preferably the group Y is piperazine or homopiperazine which can be optionally substituted by C<sub>1-4</sub> alkyl. Most  
20 preferably the group Y is piperazine, which is optionally substituted by C<sub>1-4</sub> alkyl.

Preferably the group Z is SO<sub>2</sub>, SO<sub>2</sub>CH<sub>2</sub>, C(O)CH<sub>2</sub> C(O)C(Me)<sub>2</sub>, C(O) or C(O)CH<sub>2</sub>CH<sub>2</sub>,  
.more preferably the group Z is SO<sub>2</sub>, SO<sub>2</sub>CH<sub>2</sub> or C(O)CH<sub>2</sub>.

Preferably HET is aryl, or heteroaryl, more preferably HET is phenyl or heteroaryl, most preferably HET is phenyl.

25 Preferably R<sup>6</sup> is one or more substituents selected from halogen, hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl (optionally substituted by one or more halogen atoms), alkoxy (alkyl group is optionally substituted by halogen atoms), nitro, cyano or SO<sub>2</sub>alkyl; more preferably R<sup>6</sup> is hydrogen, halogen, C<sub>1-4</sub> alkyl, O-alkyl, OCF<sub>2</sub>, OCF<sub>3</sub>, CN or SO<sub>2</sub>Me;

Preferred compounds of the invention include:

30 [2-[4-[(4-Fluorophenyl)sulfonyl]-1-piperazinyl]-4-(trifluoromethyl)phenoxy]-acetic acid;  
[2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;  
[2-[4-[[4-(4-cyanophenyl)sulfonyl]-1-piperazinylmethyl]]-4-(trifluoromethyl)phenoxy]-acetic acid;

- [2-[[4-[(2-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- [2-[[4-[(2-methylphenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- 5 [2-[[4-[(4-nitrophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- [2-[[4-[(4-fluorophenyl)sulfonyl]hexahydro-1*H*-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- [2-[hexahydro-4-[[4-(4-methoxyphenyl)sulfonyl]-1*H*-1,4-diazepin-1-yl]methyl]-4-
- 10 (trifluoromethyl)phenoxy]-acetic acid;
- [2-[[hexahydro-4-(phenylsulfonyl)-1*H*-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- [2-[[4-[(4-cyanophenyl)sulfonyl]hexahydro-1*H*-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- 15 [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[(4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[(4-chlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[[4-(trifluoromethyl)phenyl]methyl]sulfonyl]-1-piperazinyl]phenoxy]-acetic acid;
- 20 [4-chloro-2-[[4-[[4-(trifluoromethoxy)phenyl]methyl]sulfonyl]-1-piperazinyl]phenoxy]-acetic acid;
- [4-chloro-2-[4-[[4-(methylsulfonyl)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[(3-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 25 [4-chloro-2-[[4-[[3-(trifluoromethyl)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[(3-chlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[[3-(trifluoromethoxy)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 30 [4-chloro-2-[[4-[[3-(difluoromethoxy)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[4-[(3-chloro-4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;

- [4-chloro-2-[[4-[(3,4-dichlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(3,4-difluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(2-nitrophenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
5 [4-chloro-2-[[4-[(3-chlorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(4-chlorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[2-[[4-(phenylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;  
10 [4-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-Chloro-2-[[4-[(1-oxo-3-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[3-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[2-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[1-[4-(phenylsulfonyl)-1-piperazinyl]ethyl]phenoxy]-acetic acid trifluoroacetate  
15 salt;  
[2-[1-(4-benzoyl-1-piperazinyl)ethyl]-4-chlorophenoxy]-acetic acid, trifluoroacetate salt;  
[4-chloro-2-[[[1-[(phenylmethyl)sulfonyl]-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid;  
20 [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid;  
[4-chloro-2-[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]phenoxy]-acetic acid;  
[4-chloro-2-[4-(phenylacetyl)-1-piperazinyl]phenoxy]-acetic acid;  
[2-[(4-benzoyl-1-piperazinyl)methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;  
[2-[[4-(2-thienylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;  
25 [4-Chloro-2-[[4-[(4-fluorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;  
[4-Chloro-2-[[4-[(4-methylphenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;  
[4-Chloro-2-[[4-[(3-methylphenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic  
30 acid;  
[4-Chloro-2-[[4-[(2-pyridinylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy] acetic acid;  
[4-Chloro-2-[[4-[(3-pyridinylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy] acetic acid;  
[4-Chloro-2-[[4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;

- [4-Chloro-2-[[4-[(4-fluorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;  
[4-Chloro-2-[[4-[(4-methoxyphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;  
[4-Chloro-2-[[4-(3-pyridinylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid;  
[4-Chloro-2-[[4-[(4-cyanophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;  
5 [4-Chloro-2-[[2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy] acetic acid;  
[4-Chloro-2-[[2-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;  
[4-Chloro-2-[[2-*R*)-2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid;  
[4-Chloro-2-[[3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;  
10 acid;  
[4-Chloro-2-[[3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]acetic acid;  
[4-Chloro-2-[[3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid;  
[4-Chloro-2-[[3*S*)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid;  
[4-Chloro-2-[[3*R*)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid;  
15 [4-Chloro-2-[[3*R*)-3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]  
phenoxy]acetic acid;  
[4-Chloro-2-[[3*S*)-3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]  
phenoxy]acetic acid;  
[4-Chloro-2-[[3*R*)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;  
20 [4-Chloro-2-[[3*S*)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;  
c) [4-Chloro-2-[[3*S*)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;  
[4-Chloro-2-[[3*S*)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]  
phenoxy]acetic acid;  
[2-[(4-Benzoyl-3-methyl-1-piperazinyl)methyl]-4-chlorophenoxy]acetic acid;  
25 [4-chloro-2-[[2,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-Chloro-2-[[4-(1-oxo-2-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-Chloro-2-[[3*S*)-3-ethyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[3*S*)-3-ethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;  
(*Cis*)-[4-chloro-2-[[2,3-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]- acetic acid;  
30 acid;  
[4-chloro-2-[[3*S*)-4-(phenylsulfonyl)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-Chloro-2-[[3*S*)-4-(phenylacetyl)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

- [4-chloro-2-[[[(3*R*,5*S*)-3,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic acid;
- [4-chloro-2-[[hexahydro-4-(phenylsulfonyl)-1*H*-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid;
- 5 [4-chloro-2-[[hexahydro-4-[(phenylmethyl)sulfonyl]-1*H*-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[hexahydro-4-(phenylacetyl)-1*H*-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid;
- [4-Fluoro-2-[4-(phenyl)acetyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-Fluoro-2-[[4-[(phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 10 [4-Fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- (2*S*)-2-[4-fluoro-2-[[4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-fluoro-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 15 [4-chloro-2-[[methyl[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid;
- [4-Cyano-2-[[[(3*S*)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;
- [4-Methyl-2-[[[(3*S*)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;
- [2-[[[(3*S*)-3-Methyl-4-(phenylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl) phenoxy]acetic acid;
- 20 [4-(1-methylethyl)-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl] phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(2,4-difluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl] phenoxy]-acetic acid;
- 25 [4-chloro-2-[[[(3*S*)-4-[(3-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(3-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(2-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 30 acid;
- [4-chloro-2-[[[(3*S*)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

- [4-chloro-2-[[[(3*S*)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 5 [4-chloro-2-[[[(3*S*)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl] phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-
- 10 piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(3-fluoro-4-methylphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[[3-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 15 [4-chloro-2-[[[(3*S*)-3-methyl-4-[[4-(trifluoromethoxy)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[2-(4-chlorophenyl)-2-methyl-1-oxopropyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3*S*)-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-
- 20 acetic acid;
- [2-[[[(3*S*)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;
- [2-[[[(3*S*)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic aci
- 25 (2*S*)-2-[4-chloro-2-[(3*S*)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[(3*S*)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[[(3*S*)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-
- 30 propanoic acid;
- (2*S*)-2-[4-chloro-2-[[[(3*S*)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;

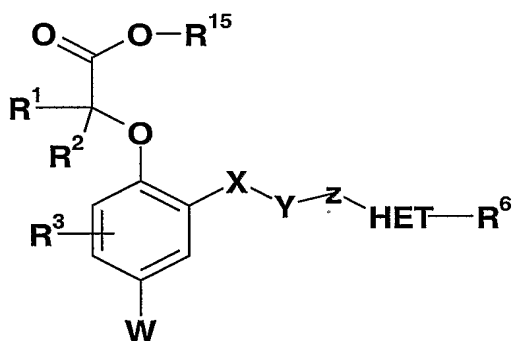
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 5 (2*S*)-2-[4-chloro-2-[[*(3S)*-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 10 (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-3-methyl-4-[[4-(1-methylethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 15 [2-[[*(3S)*-3-methyl-4-(phenylacetyl)-1-piperazinyl]-4-(trifluoromethyl)methyl]phenoxy]-acetic acid;
- 2-[4-chloro-2-[[*(3S)*-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-2-methylpropanoic acid;
- [4-chloro-2-[[*(3S)*-3-(1-methylethyl)-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 20 (2*S*)-2-[4-chloro-2-[[3-oxo-4-(phenylmethyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- and pharmaceutically acceptable salts thereof.

Certain compounds of formula (I) are capable of existing in stereoisomeric forms. It will be understood that the invention encompasses all geometric and optical isomers of the compounds of formula (I) and mixtures thereof including racemates. Tautomers and mixtures thereof also form an aspect of the present invention.

The compound of formula (I) above may be converted to a pharmaceutically acceptable salt or solvate thereof, preferably a basic addition salt such as sodium, potassium, calcium, aluminium, lithium, magnesium, zinc, benzathine, chlorprocaine, choline, diethanolamine, ethanolamine, ethyldiamine, meglumine, tromethamine or procaine, or an acid addition salt such as a hydrochloride, hydrobromide, phosphate, acetate, fumarate, maleate, tartrate, citrate, oxalate, methanesulphonate or *p*-toluenesulphonate.

It will be appreciated by those skilled in the art that in the processes of the present invention certain functional groups in the starting reagents or intermediate compound may need to be protected by protecting groups. Thus, the preparation of the compound of formula (I) may involve, at an appropriate stage, the removal of one or more protecting groups. The protection and deprotection of functional groups is fully described in 'Protective Groups in Organic Chemistry', edited by J. W. F. McOmie, Plenum Press (1973), and 'Protective Groups in Organic Synthesis', 3rd edition, T. W. Greene & P. G. M. Wuts, Wiley-Interscience (1999).

Compounds of formula (I) can be prepared by reaction of a compound of formula (II):



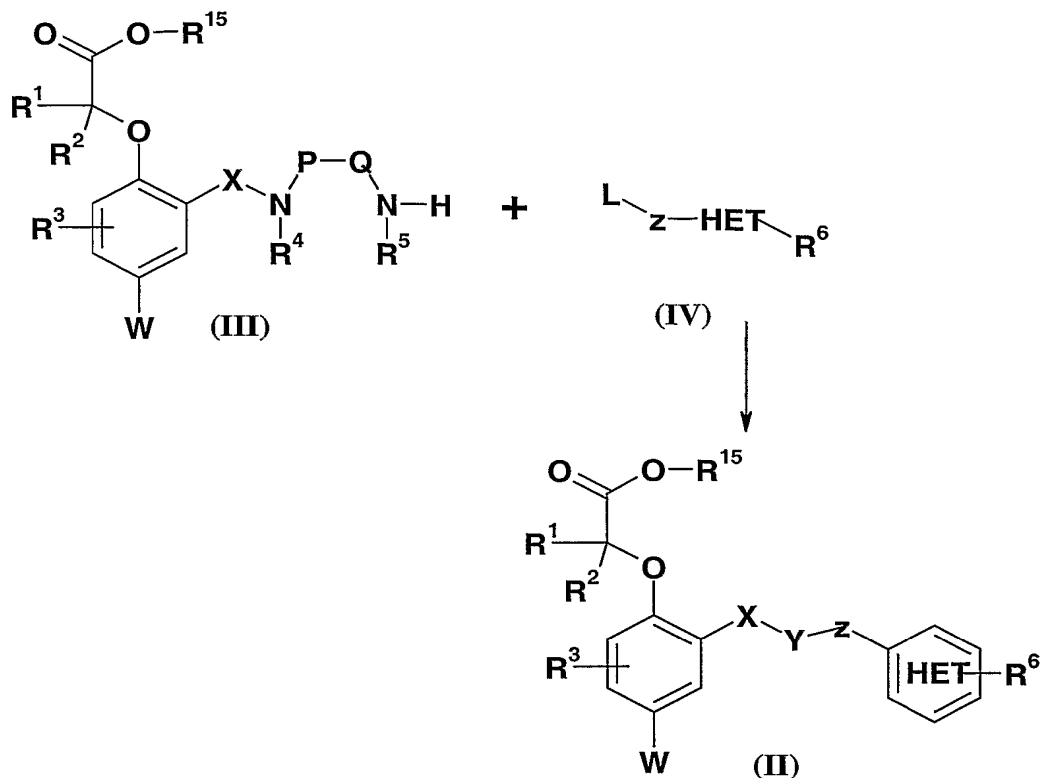
(II)

Where  $R^{15}$  is methyl, ethyl or *tert*iary butyl, and can be removed under acidic or basic conditions for example by stirring in trifluoroacetic acid or dilute sodium hydroxide in a suitable solvent such as dichloromethane, THF or methanol.  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^6$ , W, X, Y and Z are as defined in compounds of formula (I) or protected derivatives thereof.

Compounds of formula (II) are prepared from compounds of formula (III) as described in Route A.

When Z is  $SO_2$ , or C(O) the compounds of formula (III) are reacted with sulfonyl chlorides or acid chlorides of formula (IV) in which L=Chlorine. The reaction is carried out in the presence of a base such as triethylamine, aqueous sodium hydrogen carbonate or potassium carbonate in a suitable organic solvent such as dichloromethane. When Z is alkyl compounds of formula (III) are reacted with alkyl chlorides using a suitable base such as triethylamine or sodium hydride in an organic solvent such as DMF or dichloromethane.

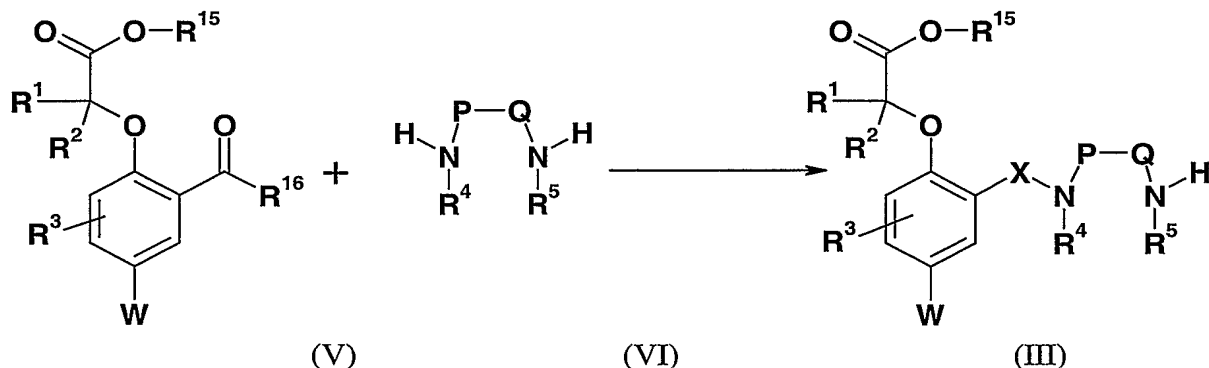
When L=OH and Z = C(O) the reaction is carried out using a coupling reagent such as HATU in a suitable polar organic solvent such as DMF or NMP.



### Route A

Where  $\text{R}^1, \text{R}^2, \text{R}^3, \text{R}^4, \text{R}^5, \text{R}^6, \text{R}^{15}, \text{P}, \text{Q}, \text{W}, \text{X}, \text{Y}$  and  $\text{Z}$  are as defined in compounds of formula (II) or protected derivatives thereof. Compounds of formula (IV) are commercially available or can be prepared readily by those skilled in the art.

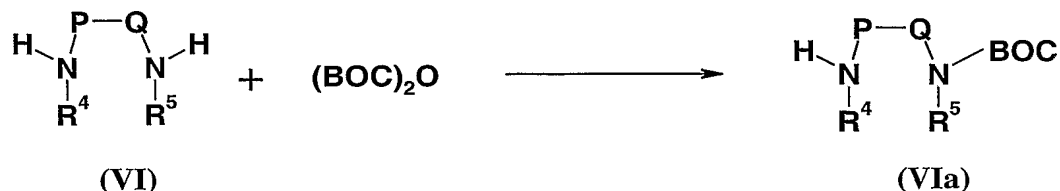
Compounds of formula (III) can be prepared from compounds of formula (V) by reacting with a diamine compound of formula (VI), by a reductive amination using triacetoxy borohydride in a suitable organic solvent for example NMP, THF or dichloromethane.



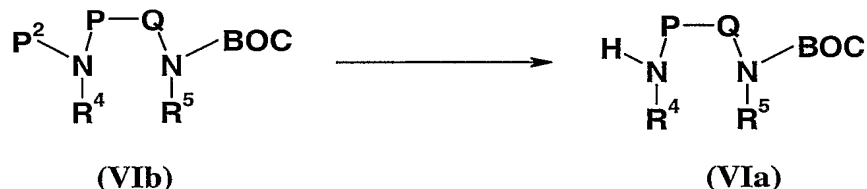
Where  $\text{R}^1, \text{R}^2, \text{R}^3, \text{R}^4, \text{R}^5, \text{R}^{15}, \text{P}, \text{Q}, \text{W}, \text{X}, \text{Y}$  and  $\text{Z}$  are as defined in compounds of formula (II) or protected derivatives thereof.  $\text{R}^{16}$  is hydrogen or  $\text{C}_1\text{-C}_6$  alkyl as defined for  $\text{X}$  in compounds of formula (I).

The diamine compound of formula (VI) is monoprotected with a suitable amine protecting group such as BOC (tert-butyl carbonyl). This protecting group is subsequently removed under acidic conditions, for example TFA.

Compounds of formula (VIa) where the amine is monoprotected with the BOC protecting group are commercially available or may be protected by reacting with compounds of formula (VI) with BOC anhydride in presence of a base for example, triethylamine in a suitable organic solvent such as dichloromethane.

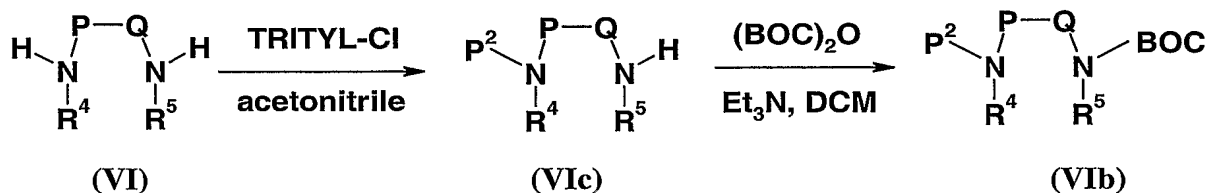


Certain compounds of formula (VIa) are prepared from compounds of formula (VIb).



Where P<sup>2</sup> is benzyl or trityl group. The benzyl protecting group is selectively removed by standard hydrogenation conditions using palladium on charcoal as catalyst in a solvent such as ethanol. The trityl protecting group can selectively be removed by reacting with acid such as dilute HCl in a suitable organic solvent such as ethanol.

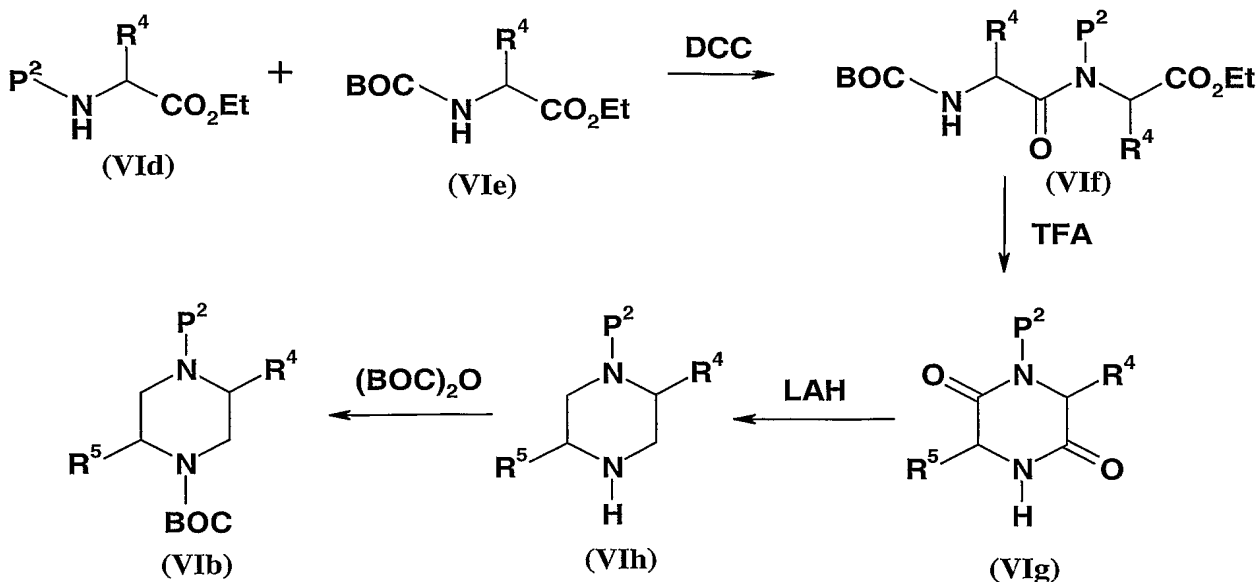
Compounds of formula (VIb) can be formed as outlined in Route B:



## Route B

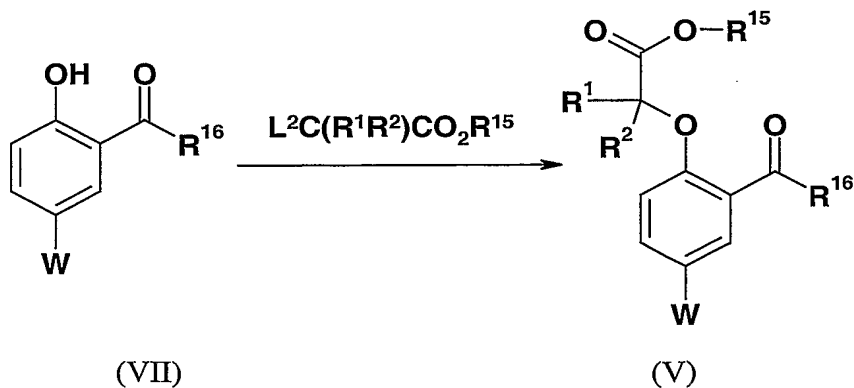
Where R<sup>4</sup>, R<sup>5</sup>, P, Q, and P<sup>2</sup> are as defined previously for compounds of formula (I) or protected derivatives thereof. P<sup>2</sup> is defined as for compounds of formula (VIb).

Some compounds of formula (VIb) are prepared as outlined in Route C (according to the method of WO03022835)



Compounds of formula (VIId) and (VId) are reacted together in the presence of a coupling reagent such as dicyclohexanecarbodiimide in a suitable organic solvent such as dichloromethane at 0°C. Compounds of formula (VIIf) are reacted with a strong acid such as TFA in a suitable solvent such as dichloromethane to give compounds of formula (VIg). The diketopiperazines of formula (VIg) can be reduced using lithiumaluminium hydride at 0°C in a suitable solvent such as THF to give compounds of formula (VIh). The compounds of formula (VIh) are reprotected with the BOC group as described previously to give compounds of formula (VIb).

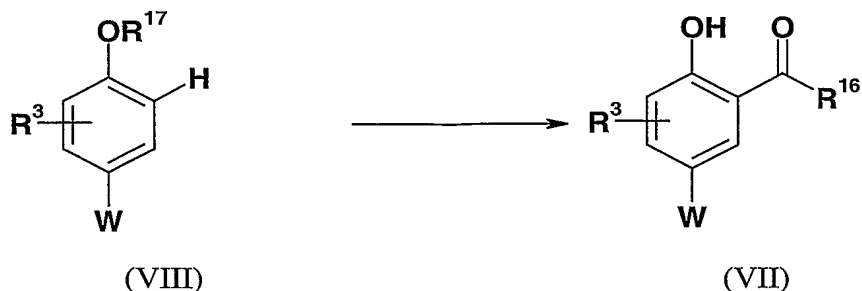
Compounds of formula (V) can be prepared from compounds of formula (VII), by reacting the phenolic compound of formula (VII) with  $L^2C(R^1, R^2)CO_2R^{15}$  in the presence of a base such as potassium carbonate in a suitable solvent such as DMF.



Where  $R^{16}$  is hydrogen or  $C_1$ - $C_6$  alkyl as defined for X in compounds of formula(I).

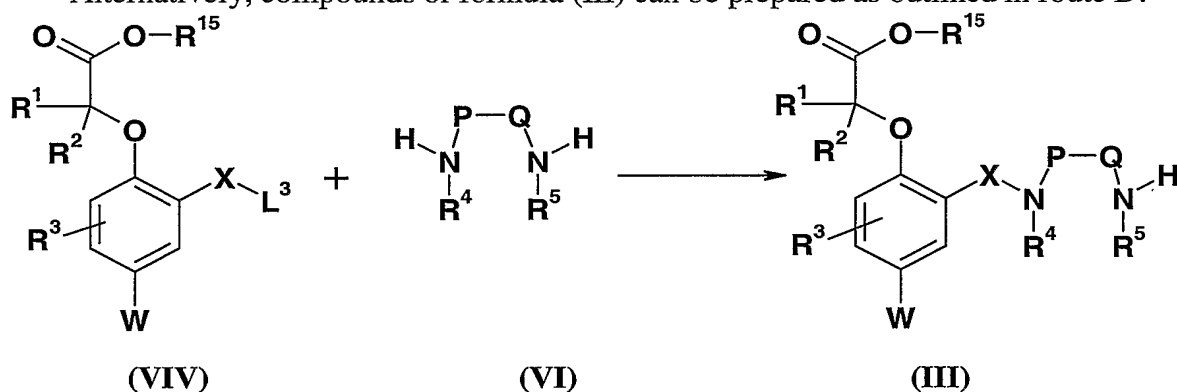
$R^1$ ,  $R^2$ , and  $W$  are as defined in compounds of formula (I) or protected derivatives thereof.  $L^2$  is a leaving group such as tosylate or a halogen atom, suitably bromine or chlorine.

Compounds of formula (VII) can be prepared from compounds of formula (VIII), by ortho lithiation using a suitable base, such as butyl lithium. The reaction is carried out at  
5  $-78^\circ\text{C}$  in an anhydrous solvent such as THF.



Where  $W$  and  $R^3$  are as defined for compounds of formula (I).  $R^{17}$  is a suitable alcohol protecting group, for example tetrahydropyran or benzyl.

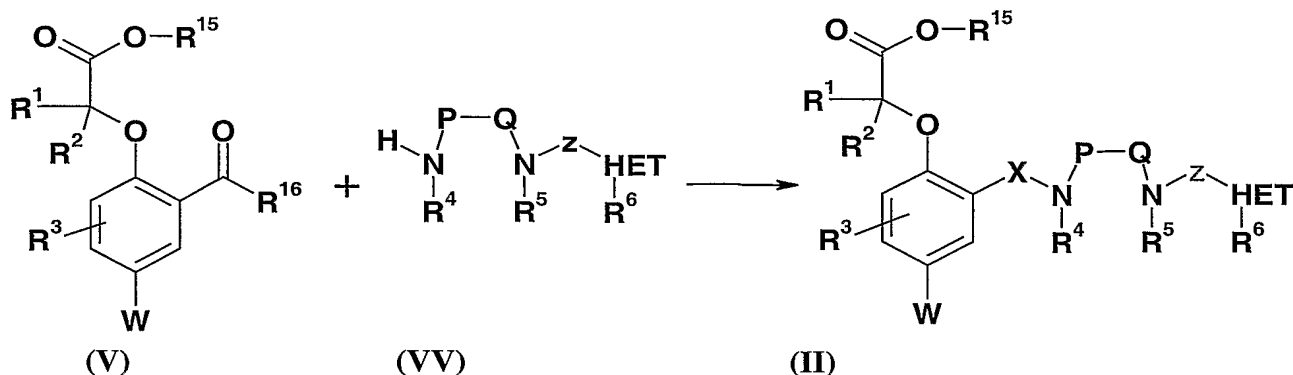
10 Alternatively, compounds of formula (III) can be prepared as outlined in route D:



#### Route D

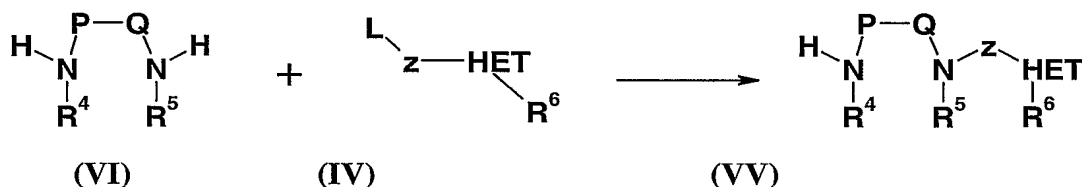
Where  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^{15}$ ,  $P$ ,  $Q$ ,  $W$  and  $X$  are as defined in compounds of formula  
15 (II) or protected derivatives thereof.  $L^3$  is a suitable leaving group such as mesylate or halogen, preferably chloro. The reaction is carried out in a suitable organic solvent such as dichloromethane in the presence of base such as triethylamine.

The sequence of any of the reactions outlined above can be reversed. For example, compounds of formula (II) may also be prepared as outlined in route E:



Compounds of formula (VV) can be reacted with compounds of formula (V) by reductive amination as outlined previously. Where  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^{15}$ ,  $P$ ,  $Q$ ,  $W$ ,  $X$ ,  $Z$  and  $HET$  are as defined in compounds of formula (II) or protected derivatives thereof.

Compounds of formula (VV) can be prepared from compounds of formula (VI) by reacting with a compound of formula (IV) as described previously in route A.



The amino group of compounds of formula (VI) may need to be protected prior to reaction with compounds of formula (IV). Suitable protecting groups are BOC, trityl or benzyl, which can be removed readily using the procedures described previously. Some protected compounds of formula (VI) are commercially available.

In a further aspect, the present invention provides the use of a compound of formula (I), a prodrug, pharmaceutically acceptable salt or solvate thereof for use in therapy.

The compounds of formula (I) have activity as pharmaceuticals, in particular as modulators of CRTh2 receptor activity, and may be used in the treatment (therapeutic or prophylactic) of conditions/diseases in human and non-human animals which are exacerbated or caused by excessive or unregulated production of  $PGD_2$  and its metabolites. Examples of such conditions/diseases include:

- (1) **(the respiratory tract)** obstructive airways diseases including: asthma (such as bronchial, allergic, intrinsic, extrinsic and dust asthma particularly chronic or inveterate asthma (e.g. late asthma and airways hyper-responsiveness)); chronic obstructive pulmonary disease (COPD)(such as irreversible COPD); bronchitis (including eosinophilic bronchitis); acute, allergic, atrophic rhinitis or chronic rhinitis (such as rhinitis caseosa, hypertrophic rhinitis, rhinitis purulenta, rhinitis sicca),

rhinitis medicamentosa, membranous rhinitis (including croupous, fibrinous and pseudomembranous rhinitis), scrofulous rhinitis, perennial allergic rhinitis, easonal rhinitis (including rhinitis nervosa (hay fever) and vasomotor rhinitis); nasal polyposis; sarcoidosis; farmer's lung and related diseases; fibroid lung; idiopathic interstitial pneumonia; cystic fibrosis; antitussive activity; treatment of chronic cough associated with inflammation or iatrogenic induced ;

(2) **(bone and joints)** arthrides including rheumatic, infectious, autoimmune, seronegative, spondyloarthropathies (such as ankylosing spondylitis, psoriatic arthritis and Reiter's disease), Behcet's disease, Sjogren's syndrome and systemic sclerosis;

(3) **(skin and eyes)** psoriasis, atopic dermatitis, contact dermatitis, other eczmatous dermatides, seborrhoetic dermatitis, Lichen planus, Pemphigus, bullous Pemphigus, Epidermolysis bullosa, urticaria, angiodermas, vasculitides, erythemas, cutaneous eosinophilias, chronic skin ulcers, uveitis, Alopecia areata, corneal ulcer and vernal conjunctivitis;

(4) **(gastrointestinal tract)** Coeliac disease, proctitis, eosinophilic gastro-enteritis, mastocytosis, Crohn's disease, ulcerative colitis, irritable bowel disease; food-related allergies which have effects remote from the gut, (such as migraine, rhinitis and eczema);

(5) **(central and peripheral nervous system)** Neurodegenerative diseases and dementia disorders (such as Alzheimer's disease, amyotrophic lateral sclerosis and other motor neuron diseases, Creutzfeldt-Jacob's disease and other prion diseases, HIV encephalopathy (AIDS dementia complex), Huntington's disease, frontotemporal dementia, Lewy body dementia and vascular dementia), polyneuropathies (such as Guillain-Barré syndrome, chronic inflammatory demyelinating polyradiculoneuropathy, multifocal motor neuropathy), plexopathies, CNS demyelination (such as multiple sclerosis, acute disseminated/haemorrhagic encephalomyelitis, and subacute sclerosing panencephalitis), neuromuscular disorders (such as myasthenia gravis and Lambert-Eaton syndrome), spinal disorders

(such as tropical spastic paraparesis, and stiff-man syndrome), paraneoplastic syndromes (such as cerebellar degeneration and encephalomyelitis), CNS trauma, migraine and stroke.

5 (6) **(other tissues and systemic disease)** atherosclerosis, acquired Immunodeficiency Syndrome (AIDS), lupus erythematosus; systemic lupus, erythematosus; Hashimoto's thyroiditis, type I diabetes, nephrotic syndrome, eosinophilia fascitis, hyper IgE syndrome, lepromatous leprosy, idiopathic thrombocytopenia pupura; post-operative adhesions, sepsis and ischemic/reperfusion injury in the heart, brain,  
10 peripheral limbs hepatitis (alcoholic, steatohepatitis and chronic viral) , glomerulonephritis, renal impairment, chronic renal failure and other organs

(7) **(allograft rejection)** acute and chronic following, for example, transplantation of kidney, heart, liver, lung, bone marrow, skin and cornea; and chronic graft versus  
15 host disease;

(8) Diseases associated with raised levels of PGD<sub>2</sub> or its metabolites.

(1) (respiratory tract) - obstructive diseases of the airways including: asthma, including  
20 bronchial, allergic, intrinsic, extrinsic, exercise-induced, drug-induced (including aspirin and NSAID-induced) and dust-induced asthma, both intermittent and persistent and of all severities, and other causes of airway hyper-responsiveness ; chronic obstructive pulmonary disease (COPD) ; bronchitis , including infectious and eosinophilic bronchitis; emphysema; bronchiectasis; cystic fibrosis; sarcoidosis;  
25 farmer's lung and related diseases; hypersensitivity pneumonitis; lung fibrosis, including cryptogenic fibrosing alveolitis, idiopathic interstitial pneumonias, fibrosis complicating anti-neoplastic therapy and chronic infection, including tuberculosis and aspergillosis and other fungal infections; complications of lung transplantation; vasculitic and thrombotic disorders of the lung vasculature, and pulmonary  
30 hypertension; antitussive activity including treatment of chronic cough associated with inflammatory and secretory conditions of the airways, and iatrogenic cough; acute and chronic rhinitis including rhinitis medicamentosa, and vasomotor rhinitis; perennial and seasonal allergic rhinitis including rhinitis nervosa (hay fever); nasal

polyposis; acute viral infection including the common cold, and infection due to respiratory syncytial virus, influenza, coronavirus (including SARS) and adenovirus.

(2) (bone and joints) arthritides associated with or including osteoarthritis/osteoarthrosis, both primary and secondary to e.g. congenital hip dysplasia; cervical and lumbar spondylitis, and low back and neck pain; rheumatoid arthritis and Still's disease; seronegative spondyloarthropathies including ankylosing spondylitis, psoriatic arthritis, reactive arthritis and undifferentiated spondarthropathy; septic arthritis and other infection-related arthropathies and bone disorders such as tuberculosis, including Potts' disease and Poncet's syndrome; acute and chronic crystal-induced synovitis including urate gout, calcium pyrophosphate deposition disease, and calcium apatite related tendon, bursal and synovial inflammation; Behcet's disease; primary and secondary Sjogren's syndrome; systemic sclerosis and limited scleroderma; systemic lupus erythematosus, mixed connective tissue disease, and undifferentiated connective tissue disease; inflammatory myopathies including dermatomyositis and polymyositis; polymyalgia rheumatica; juvenile arthritis including idiopathic inflammatory arthritides of whatever joint distribution and associated syndromes, and rheumatic fever and its systemic complications; vasculitides including giant cell arteritis, Takayasu's arteritis, Churg-Strauss syndrome, polyarteritis nodosa, microscopic polyarteritis, and vasculitides associated with viral infection, hypersensitivity reactions, cryoglobulins, and paraproteins; low back pain; Familial Mediterranean fever, Muckle-Wells syndrome, and Familial Hibernian Fever, Kikuchi disease; drug-induced arthralgias, tendonitides, and myopathies.

(3) (skin) psoriasis, atopic dermatitis, contact dermatitis or other eczematous dermatoses, and delayed-type hypersensitivity reactions; phyto- and photodermatitis; seborrhoeic dermatitis, dermatitis herpetiformis, lichen planus, lichen sclerosus et atrophica, pyoderma gangrenosum, skin sarcoid, discoid lupus erythematosus, pemphigus, pemphigoid, epidermolysis bullosa, urticaria, angioedema, vasculitides, toxic erythemas, cutaneous eosinophilias, alopecia areata, male-pattern baldness, Sweet's syndrome, Weber-Christian syndrome, erythema multiforme; cellulitis, both infective and non-infective; panniculitis; cutaneous lymphomas, non-melanoma skin

cancer and other dysplastic lesions; drug-induced disorders including fixed drug eruptions.

- 5 (4) (eyes) blepharitis; conjunctivitis, including perennial and vernal allergic conjunctivitis; iritis; anterior and posterior uveitis; choroiditis; autoimmune; degenerative or inflammatory disorders affecting the retina; ophthalmitis including sympathetic ophthalmitis; sarcoidosis; infections including viral, fungal, and bacterial.
- 10 (5) (gastrointestinal tract) glossitis, gingivitis, periodontitis; oesophagitis, including reflux; eosinophilic gastro-enteritis, mastocytosis, Crohn's disease, colitis including ulcerative colitis, proctitis, pruritis ani; coeliac disease, irritable bowel syndrome, and food-related allergies which may have effects remote from the gut (for example migraine, rhinitis or eczema).
- 15 (6) (abdominal) hepatitis, including autoimmune, alcoholic and viral; fibrosis and cirrhosis of the liver; cholecystitis; pancreatitis, both acute and chronic.
- 20 (7) (genitourinary) nephritis including interstitial and glomerulonephritis; nephrotic syndrome; cystitis including acute and chronic (interstitial) cystitis and Hunner's ulcer; acute and chronic urethritis, prostatitis, epididymitis, oophoritis and salpingitis; vulvo-vaginitis; Peyronie's disease; erectile dysfunction (both male and female).
- 25 (8) (Allograft rejection) acute and chronic following, for example, transplantation of kidney, heart, liver, lung, bone marrow, skin or cornea or following blood transfusion; or chronic graft versus host disease;
- 30 (9) (CNS) Alzheimer's disease and other dementing disorders including CJD and nvCJD; amyloidosis; multiple sclerosis and other demyelinating syndromes; cerebral atherosclerosis and vasculitis; temporal arteritis; myasthenia gravis; acute and chronic pain (acute, intermittent or persistent, whether of central or peripheral origin) including visceral pain, headache, migraine, trigeminal neuralgia, atypical facial

pain, joint and bone pain, pain arising from cancer and tumor invasion, neuropathic pain syndromes including diabetic, post-herpetic, and HIV-associated neuropathies; neurosarcoidosis; central and peripheral nervous system complications of malignant, infectious or autoimmune processes.

5

(10) Other auto-immune and allergic disorders including Hashimoto's thyroiditis, Graves' disease, Addison's disease, diabetes mellitus, idiopathic thrombocytopaenic purpura, eosinophilic fasciitis, hyper-IgE syndrome, antiphospholipid syndrome.

10

(11) Other disorders with an inflammatory or immunological component; including acquired immune deficiency syndrome (AIDS), leprosy, Sezary syndrome, and paraneoplastic syndromes.

15

(12) (Cardiovascular); atherosclerosis, affecting the coronary and peripheral circulation; pericarditis; myocarditis, inflammatory and auto-immune cardiomyopathies including myocardial sarcoid; ischaemic reperfusion injuries; endocarditis, valvulitis, and aortitis including infective (e.g. syphilitic); vasculitides; disorders of the proximal and peripheral veins including phlebitis and thrombosis, including deep vein thrombosis and complications of varicose veins.

20

(13) (Oncology) treatment of common cancers including prostate, breast, lung, ovarian, pancreatic, bowel and colon, stomach, skin and brain tumors and malignancies affecting the bone marrow (including the leukaemias) and lymphoproliferative systems, such as Hodgkin's and non-Hodgkin's lymphoma; including the prevention and treatment of metastatic disease and tumour recurrences, and paraneoplastic syndromes.

25

(14) Diseases associated with raised levels of  $\text{PGD}_2$  or its metabolites.

Thus, the present invention provides a compound of formula (I), or a pharmaceutically-  
30 acceptable salt or solvate thereof, as hereinbefore defined for use in therapy.

Preferably the compounds of the invention are used to treat diseases in which the chemokine receptor belongs to the CRTh2 receptor subfamily.

Particular conditions which can be treated with the compounds of the invention are asthma, rhinitis and other diseases in which raised levels of PGD<sub>2</sub> or its metabolites. It is preferred that the compounds of the invention are used to treat asthma.

In a further aspect, the present invention provides the use of a compound of formula (I),  
5 or a pharmaceutically acceptable salt or solvate thereof, as hereinbefore defined in the manufacture of a medicament for use in therapy.

In a further aspect, the present invention provides the use of a compound or formula (I), or a pharmaceutically acceptable salt or solvate thereof, as hereinbefore defined in the manufacture of a medicament for use in therapy in combination with drugs used to treat  
10 asthma and rhinitis (such as inhaled and oral steroids, inhaled  $\beta$ 2-receptor agonists and oral leukotriene receptor antagonists).

The invention further relates to combination therapies wherein a compound of formula (1) or a pharmaceutically acceptable salt, solvate or *in vivo* hydrolysable ester thereof, or a pharmaceutical composition or formulation comprising a compound of formula (1) is  
15 administered concurrently or sequentially or as a combined preparation with another therapeutic agent or agents, for the treatment of one or more of the conditions listed.

In particular, for the treatment of the inflammatory diseases rheumatoid arthritis, psoriasis, inflammatory bowel disease, COPD, asthma and allergic rhinitis the compounds of the invention may be combined with agents such as tumour necrosis factor alpha (TNF- $\alpha$ )  
20 inhibitors such as anti-TNF monoclonal antibodies (for example Remicade, CDP-870 and adalimumab) and TNF receptor immunoglobulin molecules (such as Enbrel); non-selective cyclo-oxygenase (COX)-1 / COX-2 inhibitors whether applied topically or systemically (such as piroxicam, diclofenac, propionic acids such as naproxen, flubiprofen, fenoprofen, ketoprofen and ibuprofen, fenamates such as mefenamic acid, indomethacin, sulindac,  
25 azapropazone, pyrazolones such as phenylbutazone, salicylates such as aspirin), COX-2 inhibitors (such as meloxicam, celecoxib, rofecoxib, valdecoxib, lumarocoxib, parecoxib and etoricoxib); glucocorticosteroids (whether administered by topical, oral, intramuscular, intravenous, or intra-articular routes); methotrexate, lefunomide; hydroxychloroquine, d-penicillamine, auranofin or other parenteral or oral gold preparations.

30 The present invention still further relates to the combination of a compound of the invention together with a leukotriene biosynthesis inhibitor, 5-lipoxygenase (5-LO) inhibitor or 5-lipoxygenase activating protein (FLAP) antagonist such as; zileuton; ABT-761; fenleuton; tepoxalin; Abbott-79175; Abbott-85761; N-(5-substituted)-thiophene-2-

alkylsulfonamides; 2,6-di-tert-butylphenol hydrazones; methoxytetrahydropyrans such as Zeneca ZD-2138; the compound SB-210661; pyridinyl-substituted 2-cyanonaphthalene compounds such as L-739,010; 2-cyanoquinoline compounds such as L-746,530; indole and quinoline compounds such as MK-591, MK-886, and BAY x 1005.

5       The present invention still further relates to the combination of a compound of the invention together with a receptor antagonist for leukotrienes( LT)B<sub>4</sub>, LTC<sub>4</sub>, LTD<sub>4</sub>, and LTE<sub>4</sub>. selected from the group consisting of the phenothiazin-3-1s such as L-651,392; amidino compounds such as CGS-25019c; benzoxalamines such as ontazolast; benzenecarboximidamides such as BIIL 284/260; and compounds such as zafirlukast,  
10   ablukast, montelukast, pranlukast, verlukast (MK-679), RG-12525, Ro-245913, iralukast (CGP 45715A), and BAY x 7195.

      The present invention still further relates to the combination of a compound of the invention together with a phosphodiesterase (PDE) inhibitor such as the methylxanthanines including theophylline and aminophylline; and selective PDE isoenzyme inhibitors including  
15   PDE4 inhibitors and inhibitors of the isoform PDE4D, and inhibitors of PDE5.

      The present invention still further relates to the combination of a compound of the invention together with histamine type 1 receptor antagonists such as cetirizine, loratadine, desloratadine, fexofenadine, acrivastine, terfenadine, astemizole, azelastine, levocabastine, chlorpheniramine, promethazine, cyclizine, and mizolastine applied orally, topically or  
20   parenterally.

      The present invention still further relates to the combination of a compound of the invention together with a gastroprotective histamine type 2 receptor antagonist.

      The present invention still further relates to the combination of a compound of the invention with antagonists of the histamine type 4 receptor.

25       The present invention still further relates to the combination of a compound of the invention together with an alpha-1/alpha-2 adrenoceptor agonist vasoconstrictor sympathomimetic agent, such as propylhexedrine, phenylephrine, phenylpropanolamine, ephedrine, pseudoephedrine, naphazoline hydrochloride, oxymetazoline hydrochloride, tetrahydrozoline hydrochloride, xylometazoline hydrochloride, tramazoline hydrochloride,  
30   and ethylnorepinephrine hydrochloride.

      The present invention still further relates to the combination of a compound of the invention together with anticholinergic agents including muscarinic receptor (M<sub>1</sub>, M<sub>2</sub>, and

M3) antagonists such as atropine, hyoscine, glycopyrrrolate, ipratropium bromide; tiotropium bromide; oxitropium bromide; pirenzepine; and telenzepine.

The present invention still further relates to the combination of a compound of the invention together with a beta-adrenoceptor agonist (including beta receptor subtypes 1-4) such as isoprenaline, salbutamol, formoterol, salmeterol, terbutaline, orciprenaline, bitolterol mesylate, and pirbuterol .

The present invention still further relates to the combination of a compound of the invention together with a chromone, including sodium cromoglycate and nedocromil sodium.

The present invention still further relates to the combination of a compound of the invention together with an insulin-like growth factor type I (IGF-1) mimetic.

The present invention still further relates to the combination of a compound of the invention together with an inhaled glucocorticoid, such as flunisolide, triamcinolone acetonide, beclomethasone dipropionate, budesonide, fluticasone propionate, ciclesonide, and mometasone furoate.

The present invention still further relates to the combination of a compound of the invention together with an inhibitor of matrix metalloproteases (MMPs), i.e., the stromelysins, the collagenases, and the gelatinases, as well as aggrecanase; especially collagenase-1 (MMP-1), collagenase-2 (MMP-8), collagenase-3 (MMP-13), stromelysin-1 (MMP-3), stromelysin-2 (MMP-10), and stromelysin-3 (MMP-11) and MMP-9 and MMP-12.

The present invention still further relates to the combination of a compound of the invention together with modulators of chemokine receptor function such as antagonists of CCR1, CCR2, CCR2A, CCR2B, CCR3, CCR4, CCR5, CCR6, CCR7, CCR8, CCR9, CCR10 and CCR11 (for the C-C family); CXCR1, CXCR2, CXCR3, CXCR4 and CXCR5 (for the C-X-C family) and CX<sub>3</sub>CR1 for the C-X<sub>3</sub>-C family.

The present invention still further relates to the combination of a compound of the invention together with a cytokine or modulator of cytokine function, including alpha-, beta-, and gamma-interferon; interleukins (IL) including IL1 to 15, and interleukin antagonists or inhibitors, including agents which act on cytokine signalling pathways.

The present invention still further relates to the combination of a compound of the invention together with an immunoglobulin (Ig) or Ig preparation or an antagonist or antibody modulating Ig function such as anti-IgE (omalizumab).

The present invention still further relates to the combination of a compound of the invention together with other systemic or topically-applied anti-inflammatory agents including thalidomide and derivatives, retinoids, dithranol, and calcipotriol.

The present invention still further relates to the combination of a compound of the  
5 invention together with an antibacterial agent including penicillin derivatives, tetracyclines, macrolides, beta-lactams, flouroquinolones, and inhaled aminoglycosides; and antiviral agents including acyclovir, famciclovir, valaciclovir, ganciclovir, cidofovir; amantadine, rimantadine; ribavirin; zanamavir and oseltamavir; protease inhibitors such as indinavir, nelfinavir, ritonavir, and saquinavir; nucleoside reverse transcriptase inhibitors such as  
10 didanosine, lamivudine, stavudine, zalcitabine, zidovudine; non-nucleoside reverse transcriptase inhibitors such as nevirapine, efavirenz.

The present invention still further relates to the combination of a compound of the invention together with cardiovascular agents such as calcium channel blockers, beta-adrenoceptor blockers, angiotensin-converting enzyme (ACE) inhibitors, angiotensin-2  
15 receptor antagonists; lipid lowering agents such as statins, and fibrates; modulators of blood cell morphology such as pentoxifylline; thrombolytics, and anticoagulants including platelet aggregation inhibitors.

The present invention still further relates to the combination of a compound of the invention together with CNS agents such as antidepressants (such as sertraline), anti-  
20 Parkinsonian drugs (such as deprenyl, L-dopa, Requip, Mirapex, MAOB inhibitors such as selegine and rasagiline, comP inhibitors such as Tasmar, A-2 inhibitors, dopamine reuptake inhibitors, NMDA antagonists, nicotine agonists, dopamine agonists and inhibitors of neuronal nitric oxide synthase), and anti-Alzheimer's drugs such as donepezil, tacrine, COX-2 inhibitors, propentofylline or metrifonate.

25 The present invention still further relates to the combination of a compound of the invention together with agents for the treatment of acute and chronic pain, including centrally and peripherally-acting analgesics such as opioid analogues and derivatives, carbamazepine, phenytoin, sodium valproate, amitryptiline and other antidepressant agents, and non-steroidal anti-inflammatory agents.

30 The present invention still further relates to the combination of a compound of the invention together with parenterally or topically-applied local anaesthetic agents such as lignocaine.

The present invention still further relates to the combination of a compound of the invention together with (i) tryptase inhibitors; (ii) platelet activating factor (PAF) antagonists; (iii) interleukin converting enzyme (ICE) inhibitors; (iv) IMPDH inhibitors; (v) adhesion molecule inhibitors including VLA-4 antagonists; (vi) cathepsins; (vii) MAP kinase inhibitors; (viii) glucose-6 phosphate dehydrogenase inhibitors; (ix) kinin-B.sub1. - and B.sub2. -receptor antagonists; (x) anti-gout agents, e.g., colchicine; (xi) xanthine oxidase inhibitors, e.g., allopurinol; (xii) uricosuric agents, e.g., probenecid, sulfinpyrazone, and benzbromarone; (xiii) growth hormone secretagogues; (xiv) transforming growth factor (TGF $\beta$ ); (xv) platelet-derived growth factor (PDGF); (xvi) fibroblast growth factor, e.g., basic fibroblast growth factor (bFGF); (xvii) granulocyte macrophage colony stimulating factor (GM-CSF); (xviii) capsaicin cream; (xix) Tachykinin NK.sub1. and NK.sub3. receptor antagonists selected from the group consisting of NKP-608C; SB-233412 (talnetant); and D-4418; (xx) elastase inhibitors selected from the group consisting of UT-77 and ZD-0892; (xxi) TNF $\alpha$  converting enzyme inhibitors (TACE); (xxii) induced nitric oxide synthase inhibitors (iNOS) or (xxiii) chemoattractant receptor-homologous molecule expressed on TH2 cells, (CRTH2 antagonists) (xxiv) inhibitors of P38

The compounds of the present invention may also be used in combination with anti-osteoporosis agents including hormonal agents such as raloxifene, and biphosphonates such as alendronate.

The compounds of the invention may also be used in combination with existing therapeutic agents for the treatment of osteoarthritis. Suitable agents to be used in combination include standard non-steroidal anti-inflammatory agents (hereinafter NSAIDs) such as piroxicam, diclofenac, propionic acids such as naproxen, flubiprofen, fenoprofen, ketoprofen and ibuprofen, fenamates such as mefenamic acid, indomethacin, sulindac, apazone, pyrazolones such as phenylbutazone, salicylates such as aspirin, COX-2 inhibitors such as celecoxib, valdecoxib, rofecoxib and etoricoxib, analgesics, and intra-articular therapies such as corticosteroids and hyaluronic acid derivatives, and nutritional supplements such as glucosamine.

The compounds of the invention can also be used in combination with existing therapeutic agents for the treatment of cancer. Suitable agents to be used in combination include:

(i) antiproliferative/antineoplastic drugs and combinations thereof, as used in medical oncology, such as alkylating agents (for example cis-platin, carboplatin, cyclophosphamide,

nitrogen mustard, melphalan, chlorambucil, busulphan and nitrosoureas); antimetabolites (for example antifolates such as fluoropyrimidines like 5-fluorouracil and tegafur, raltitrexed, methotrexate, cytosine arabinoside, hydroxyurea, gemcitabine and paclitaxel; antitumour antibiotics (for example anthracyclines like adriamycin, bleomycin, doxorubicin, daunomycin, epirubicin, idarubicin, mitomycin-C, dactinomycin and mithramycin); antimitotic agents (for example vinca alkaloids like vincristine, vinblastine, vindesine and vinorelbine and taxoids like taxol and taxotere); and topoisomerase inhibitors (for example epipodophyllotoxins like etoposide and teniposide, amsacrine, topotecan and camptothecins);

(ii) cytostatic agents such as antioestrogens (for example tamoxifen, toremifene, raloxifene, droloxifene and idoxifene), oestrogen receptor down regulators (for example fulvestrant), antiandrogens (for example bicalutamide, flutamide, nilutamide and cyproterone acetate), LHRH antagonists or LHRH agonists (for example goserelin, leuporelin and buserelin), progestogens (for example megestrol acetate), aromatase inhibitors (for example anastrozole, letrozole, vorazole and exemestane) and inhibitors of 5 $\alpha$ -reductase such as finasteride;

(iii) Agents which inhibit cancer cell invasion (for example metalloproteinase inhibitors like marimastat and inhibitors of urokinase plasminogen activator receptor function);

(iv) inhibitors of growth factor function, for example such inhibitors include growth factor antibodies, growth factor receptor antibodies (for example the anti-erbB2 antibody trastuzumab and the anti-erbB1 antibody cetuximab [C225]), farnesyl transferase inhibitors, tyrosine kinase inhibitors and serine/threonine kinase inhibitors, for example inhibitors of the epidermal growth factor family (for example EGFR family tyrosine kinase inhibitors such as N-(3-chloro-4-fluorophenyl)-7-methoxy-6-(3-morpholinopropoxy)quinazolin-4-amine (gefitinib, AZD1839), N-(3-ethynylphenyl)-6,7-bis(2-methoxyethoxy)quinazolin-4-amine (erlotinib, OSI-774) and 6-acrylamido-N-(3-chloro-4-fluorophenyl)-7-(3-morpholinopropoxy)quinazolin-4-amine (CI 1033)), for example inhibitors of the platelet-derived growth factor family and for example inhibitors of the hepatocyte growth factor family;

(v) antiangiogenic agents such as those which inhibit the effects of vascular endothelial growth factor, (for example the anti-vascular endothelial cell growth factor antibody bevacizumab, compounds such as those disclosed in International Patent Applications WO 97/22596, WO 97/30035, WO 97/32856 and WO 98/13354) and compounds that work

by other mechanisms (for example linomide, inhibitors of integrin  $\alpha v \beta 3$  function and angiostatin);

(vi) vascular damaging agents such as combretastatin A4 and compounds disclosed in International Patent Applications WO 99/02166, WO00/40529, WO 00/41669, WO01/92224,  
5 WO02/04434 and WO02/08213;

(vii) antisense therapies, for example those which are directed to the targets listed above, such as ISIS 2503, an anti-ras antisense;

(viii) gene therapy approaches, including for example approaches to replace aberrant genes such as aberrant p53 or aberrant BRCA1 or BRCA2, GDEPT (gene-directed enzyme  
10 pro-drug therapy) approaches such as those using cytosine deaminase, thymidine kinase or a bacterial nitroreductase enzyme and approaches to increase patient tolerance to chemotherapy or radiotherapy such as multi-drug resistance gene therapy; and

(ix) immunotherapy approaches, including for example ex-vivo and in-vivo approaches to increase the immunogenicity of patient tumour cells, such as transfection with cytokines  
15 such as interleukin 2, interleukin 4 or granulocyte-macrophage colony stimulating factor, approaches to decrease T-cell anergy, approaches using transfected immune cells such as cytokine-transfected dendritic cells, approaches using cytokine-transfected tumour cell lines and approaches using anti-idiotypic antibodies.

In a still further aspect, the present invention provides the use of a compound of formula  
20 (I), or a pharmaceutically acceptable salt or solvate thereof, as hereinbefore defined in the manufacture of a medicament for the treatment of human diseases or conditions in which modulation of CRTh2 receptor activity is beneficial.

In the context of the present specification, the term "therapy" also includes "prophylaxis" unless there are specific indications to the contrary. The terms "therapeutic"  
25 and "therapeutically" should be construed accordingly.

The invention still further provides a method of treating diseases mediated by PGD2 or its metabolites wherein the prostanoid binds to its receptor (especially CRTh2) receptor, which comprises administering to a patient a therapeutically effective amount of a compound of formula (I), or a pharmaceutically acceptable salt, solvate or prodrug thereof, as  
30 hereinbefore defined.

The invention also provides a method of treating an inflammatory disease, especially psoriasis, in a patient suffering from, or at risk of, said disease, which comprises

administering to the patient a therapeutically effective amount of a compound of formula (I), or a pharmaceutically acceptable salt or solvate thereof, as hereinbefore defined.

For the above-mentioned therapeutic uses the dosage administered will, of course, vary with the compound employed, the mode of administration, the treatment desired and the  
5 disorder indicated.

For the above-mentioned therapeutic uses the dosage administered will, of course, vary with the compound employed, the mode of administration, the treatment desired and the disorder indicated.

The compound of formula (I), prodrugs and pharmaceutically acceptable salts and  
10 solvates thereof may be used on their own but will generally be administered in the form of a pharmaceutical composition in which the formula (I) compound/salt/solvate (active ingredient) is in association with a pharmaceutically acceptable adjuvant, diluent or carrier. Depending on the mode of administration, the pharmaceutical composition will preferably comprise from 0.05 to 99 %w (per cent by weight), more preferably from 0.05 to 80 %w, still  
15 more preferably from 0.10 to 70 %w, and even more preferably from 0.10 to 50 %w, of active ingredient, all percentages by weight being based on total composition.

The present invention also provides a pharmaceutical composition comprising a compound of formula (I), or a pharmaceutically acceptable salt or solvate thereof, as herein before defined, in association with a pharmaceutically acceptable adjuvant, diluent or carrier.

20 The pharmaceutical compositions may be administered topically (e.g. to the lung and/or airways or to the skin) in the form of solutions, suspensions, heptafluoroalkane aerosols and dry powder formulations; or systemically, e.g. by oral administration in the form of tablets, capsules, syrups, powders or granules, or by parenteral administration in the form of solutions or suspensions, or by subcutaneous administration or by rectal administration in the form of  
25 suppositories or transdermally. Preferably the compound of the invention is administered orally.

The invention will now be illustrated by the following non-limiting examples in which, unless stated otherwise:

(i) when given,  $^1\text{H}$  NMR data is quoted in the form of delta values for major diagnostic  
30 protons, given in parts per million (ppm) relative to tetramethylsilane (TMS) as an internal standard;

(ii) mass spectra (MS): generally only ions which indicate the parent mass are reported, and unless otherwise stated the mass ion quoted is the positive mass ion -  $(\text{M}+\text{H})^+$ ;

(iii) the title compounds of the examples and methods were named using the ACD/name and ACD/name batch (version 6.0) from Advanced Chemical Development Inc, Canada;

(iv) unless stated otherwise, reverse phase HPLC was conducted using a Symmetry, NovaPak or Ex-Terra reverse phase silica column;

5 (v) solvents were dried with MgSO<sub>4</sub> or Na<sub>2</sub>SO<sub>4</sub>

(vi) the following abbreviations are used:

	EtOAc	Ethylacetate
	DCM	Dichloromethane
10	NMP	N-methylpyrrolidine
	DMF	N,N-dimethylformamide
	THF	tetrahydrofuran
	mcpba	3-chloroperoxybenzoic acid (Aldrich 77% max)
		Pd(dppf)Cl <sub>2</sub> [1,1'-
15		<i>Bis</i> (diphenylphosphino)ferrocene]dichloropalladium(II), complex with dichloromethane
	RT	room temperature
	RPHPLC	reverse phase high performance liquid chromatography
	h	hours
20	HCl	hydrochloric acid
	BOC	<i>tertiary</i> -butylcarbonyl
	HATU	<i>O</i> -(7-Azabenzotriazol-1-yl)- <i>N,N,N',N'</i> -tetramethyluronium hexafluorophosphate

### **Example 1**

#### 25 **[2-[4-[(4-Fluorophenyl)sulfonyl]-1-piperazinyl]-4-(trifluoromethyl)phenoxy]-acetic acid** **a) Tetrahydro-2-[4-(trifluoromethyl)phenoxy]-2H-pyran**

A solution of 4-(Trifluoromethyl)-phenol (40 g) in dichloromethane (100 ml) was added at 0°C dropwise to a solution of dihydropyran (53 g) in dichloromethane (100 ml) and aqueous HCl (200 µl). The reaction was allowed to reach room temperature, then quenched  
30 with saturated sodium bicarbonate (x1). The organic layer was separated and dried (MgSO<sub>4</sub>), concentrated *in vacuo* to give the sub-title compound (81 g)

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.53 (2H, d); 7.13 (2H, d); 5.48 (1H, t); 3.9 (1H, td); 3.63 (1H, dt); 2.1-.5 (6H, m)

**b) 2-[(tetrahydro-2H-pyran-2-yl)oxy]-5-(trifluoromethyl)-benzaldehyde**

n-BuLi [2.5M hexanes] (31 ml) was added over 15 minutes at  $-78^{\circ}\text{C}$  under nitrogen to a solution of the product from step a) (20.8 g) in dry THF (200 ml). After stirring for 30 min DMF (9 ml) was added and the reaction mixture was allowed to reach room temperature. The  
5 reaction was quenched with water and extracted with ethyl acetate. The organic phase was washed with water (x2), brine (x1), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo* to give the sub-title compound (22.75 g)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  10.55 (1H, s); 8.11 (1H, d); 7.77 (1H, dd); 7.37 (1H, d); 5.66 (1H, s); 3.9-3.65 (2H, m), 2.1-1.5 (6H, m).

10

**c) 2-hydroxy-5-(trifluoromethyl)-benzaldehyde**

The product from part b) (22.75 g) was dissolved in THF (40 ml) and treated with 2M HCl (85 ml). After 2 hours the reaction mixture was diluted with ethyl acetate and the phases separated. The organic layer was washed (brine), dried ( $\text{MgSO}_4$ ), concentrated *in vacuo* to  
15 give the sub-title compound (18 g).

MS: APCI (-ve): 189 (M-1)

**d) 1,1-dimethylethyl ester [2-formyl-4-(trifluoromethyl)phenoxy]-acetic acid**

Potassium carbonate (12 g) was added to a solution of phenol (11 g) and *tert*-  
20 butylbromoacetate (11.5 ml) in NMP (40 ml). The reaction was stirred for 2 hours, then diluted with ethyl acetate and washed with water, brine, dried ( $\text{MgSO}_4$ ), and concentrated *in vacuo* to give the sub-title compound (19 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  10.55 (1H, s); 8.15 (1H, d); 7.78 (1H, dd); 6.96 (1H, d); 4.72 (2H, s), 1.5 (9H, s).

25

**e) [2-(1-piperazinylmethyl)-4-(trifluoromethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester**

The product of part d) (1 g) and BOC piperidine (900 mg) were dissolved in NMP (10 ml) and sodium triacetoxy borohydride (1.7 g) was added and stirred for 1.5 hours. The  
30 reaction was quenched with water and extracted with ethyl acetate. The organic layer was washed with water, brine, dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo* to give the sub-title compound (1.75 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  7.68 (1H, s); 7.47 (1H, d); 6.76 (1H, d), 4.57(2H, s), 3.65(2H,s), 3.45 (4H,t), 2.46 (4H,s), 1.48 (9H,s), 1.45 (9H,s).

The crude material (1.1 g) was dissolved DCM (30 ml) and treated with TFA (2 ml) and concentrated to give the sub-title compound (1.1 g).

5  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  7.68 (1H, s); 7.44 (1H, dd); 6.76 (1H, d), 4.57(2H, s), 3.64(2H,s), 2.94 (2H, s), 2.52 (4H, t), 1.48 (9H, s).

**f) [2-[[4-[(4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**

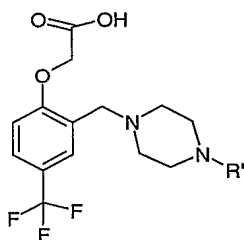
10 The product from part e) (210 mg) was dissolved in DCM (15 ml) and treated with triethylamine (500  $\mu\text{l}$ ) and 4-fluorobenzenesulfonyl chloride (150 mg), the reaction mixture was stirred overnight. The reaction was concentrated *in vacuo* then redissolved in ethyl acetate, washed with  $\text{NaHCO}_3$ , brine, dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. The residue was purified using SCX resin (washed with MeOH and eluted with ammonia). The resulting

15 product was dissolved in DCM and TFA (2 ml) and stirred overnight, then concentrated *in vacuo*. The product was further purified by LCMS directed purification to give the title compound (90 mg)

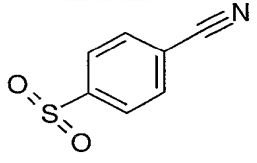
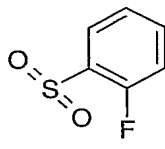
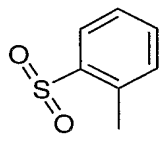
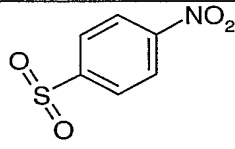
MS: APCI (-ve): 475 (M-1)

The following compounds were synthesised from the product of Example1 part e) using

20 the method of eexample 1 part f)

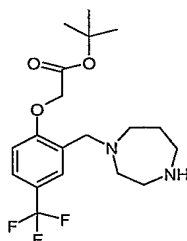


Example number	EXAMPLE	R'	M/Z
2	[2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid		457 [M-H]

3	[2-[4-[[4-(4-cyanophenyl)sulfonyl]-1-piperazinylmethyl]]-4-(trifluoromethyl)phenoxy]-acetic acid		482 [M-H]
4	[2-[[4-[(2-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid		475 [M-H]
5	[2-[[4-[(2-methylphenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid		471 [M-H]
6	[2-[[4-[(4-nitrophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid		438 [M-H]

Synthesis of Intermediate 7a (used for synthesis of Examples (7-10))

**7a) [2-[(hexahydro-1H-1,4-diazepin-1-yl)methyl]-4-(trifluoromethyl)phenoxy]-1,1-dimethylethyl ester acetic acid**



The sub-title compound was prepared by the method of Example 1 part f) using BOC-homopiperazine ([1,4]Diazepane-1-carboxylic acid tert-butyl ester) and the product from Example 1 part d)

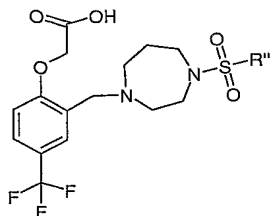
<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.75 (1H, s); 7.45 (1H, d); 6.75 (1H, d), 4.57(2H, s), 3.76(2H,s), 3.6-3.45(4H,m), 2.83-2.6 (4H, m), 1.95-1.8 (2H, m), 1.48 (18H, s).

The intermediate was dissolved in DCM (100 ml) and treated with TFA (30 ml), to give the sub-title compound.

MS: APCI (+ve): 389 (M+1)

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.58 (1H, s); 7.49 (1H, d); 4.6(2H, s), 3.81(2H,s), 3.29(4H,m), 3.21 (2H, t), 2.93 (2H, t), 2.81 (2H, t), 2.10-1.9 (2H, m), 1.48 (9H, s).

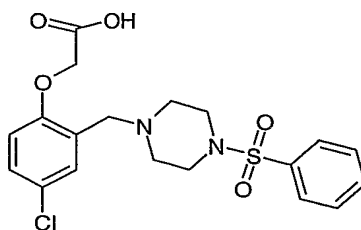
The following examples (7-10) were synthesised using intermediate 7a by the method of example 1 part f)



Example number	EXAMPLE	R''	M/Z [M+H]
7	[2-[[4-[(4-fluorophenyl)sulfonyl]hexahydro-1H-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl) phenoxy]-acetic acid		491.6
8	[2-[hexahydro-4-[[4-(methoxyphenyl)sulfonyl]-1H-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid		503.6
9	[2-[[hexahydro-4-(phenylsulfonyl)-1H-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid		473.6
10	[2-[[4-[(4-cyanophenyl)sulfonyl]hexahydro-1H-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl) phenoxy]-acetic acid		498.6

#### 5 Example 11

#### [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid



**a) [4-chloro-2-(1-piperazinylmethyl)phenoxy]-acetic acid, ethyl ester**

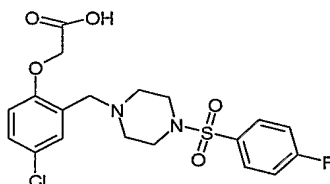
The sub-title compound was prepared by the method of Example 1 part e) from (4-chloro-2-formylphenoxy)-acetic acid, ethyl ester. The sub-title compound was used directly in the following step reaction.

**b) [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinylmethyl]phenoxy]-acetic acid**

The product of example 11 part b (300 mg) was dissolved in THF (10 ml) and triethylamine (0.28 ml). The sulfonyl chloride (1.1 equivalents) was added and stirred for 3 h. 1M NaOH (3 ml) was added and stirred for 2 hours. Acetic acid (5 ml) was added and then the reaction mixture was concentrated *in vacuo*. The residue was further purified by RPHPLC to give the sub-title compound (0.19 g).

MS: APCI (-ve): 423 (M-1)

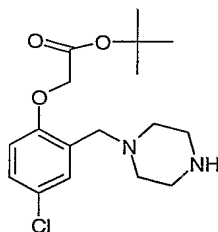
<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.77-7.72 (3H, m), 7.66 (2H, m), 7.22 (2H, d), 4.58 (2H, s), 3.55 (2H, s), 2.97 - 2.90 (4H, m), 2.57-2.50 (4H, m)

**Example 12****[4-chloro-2-[[4-[(4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared from Example 11 part a) and 4-fluoro-benzene sulfonyl chloride, by the method of example 11 part b)

MS: APCI (-ve): 441 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.81 (2H, m), 7.49 (2H, m), 7.26 (1H, m), 7.24 (1H, m), 6.94 (1H, d), 4.65 (2H, s), 3.57 (2H, s), 3.00-2.90 (4H, m), 2.61-2.51 (4H, m).

**Synthesis of Intermediate Example 13b****[4-chloro-2-(1-piperazinylmethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester****a) (4-chloro-2-formylphenoxy)-acetic acid, 1,1-dimethylethyl ester**

The sub-title compound was prepared by the method of Example 1 part d) using 5-chloro-2-hydroxybenzaldehyde (40 g), potassium carbonate (40 g), acetone (400 ml) and *tert*-butyl bromoacetate (37 ml) (yield = 45.5g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 10.5 (1H, s); 7.81 (1H, d); 7.47 (1H, dd), 6.82 (1H, d), 4.64(2H,s), 1.48  
10 (9H, s).

**b) [4-chloro-2-(1-piperazinylmethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester**

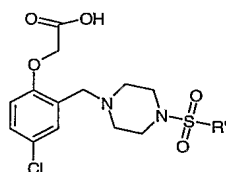
The sub-title compound was prepared by the method of Example 1 part e) using the product of part a).

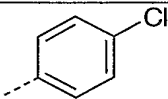
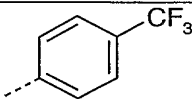
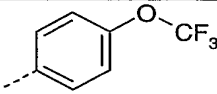
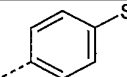
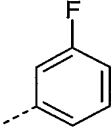
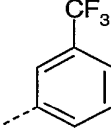
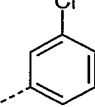
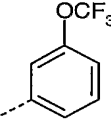
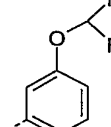
15

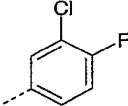
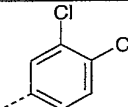
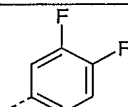
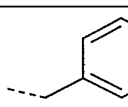
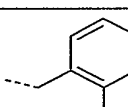
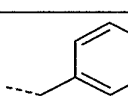
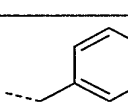
**Synthesis of examples 13-28**

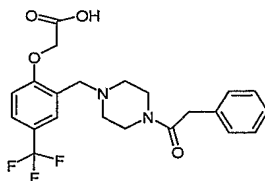
Examples 13-28 were synthesised using the following procedure:-

The product of example 13 part b (300 mg) was dissolved in THF (10 ml) and triethylamine (0.28 ml). The sulfonyl chloride (1.1 equivalents) was added and stirred for 3 h. 1M NaOH  
20 (3 ml) was added and stirred for 2 hours. Acetic acid (5 ml) was added and then the reaction mixture was concentrated *in vacuo*. The residue was further purified by RPHPLC.



Example number	EXAMPLE	R'	M/Z [M-H]
13	[4-chloro-2-[[4-[(4-chlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		457
14	[4-chloro-2-[[4-[(4-(trifluoromethyl)phenyl)methyl]sulfonyl]-1-piperazinyl]phenoxy]-acetic acid		491
15	[4-chloro-2-[[4-[(4-(trifluoromethoxy)phenyl)methyl]sulfonyl]-1-piperazinyl]phenoxy]-acetic acid		509
16	[4-chloro-2-[4-[[4-(methylsulfonyl)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		501
17	[4-chloro-2-[[4-[(3-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		441
18	[4-chloro-2-[[4-[(3-(trifluoromethyl)phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		491
19	[4-chloro-2-[[4-[(3-chlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		457
20	[4-chloro-2-[[4-[(3-(trifluoromethoxy)phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		507
21	[4-chloro-2-[[4-[(3-(difluoromethoxy)phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		489

22	[4-chloro-2-[[4-[(3-chloro-4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		474
23	[4-chloro-2-[[4-[(3,4-dichlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		492
24	[4-chloro-2-[[4-[(3,4-difluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		459
25	[4-chloro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		437
26	[4-chloro-2-[[4-[(2-nitrophenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		482
27	[4-chloro-2-[[4-[(3-chlorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		471
28	[4-chloro-2-[[4-[(4-chlorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid		471

**Example 29****[2-[[4-(phenylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**

5

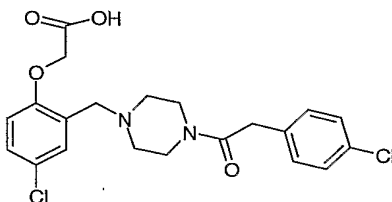
The product of example 1 part e) (0.1 mmol) in NMP (100  $\mu$ l) and HATU (0.1 mmol) in NMP (100  $\mu$ l) were added to phenylacetic acid (0.1 mmol) and stirred for 24 hours. Methanol (100  $\mu$ l) was added, stirred for 5 minutes and evaporated *in vacuo* to dryness. TFA/DCM [1:1] (400  $\mu$ l) was added and vortex mixed for 96 hours, followed by centrifugal evaporation

to dryness. The product was purified by LCMS directed purification to give the title compound.

MS: APCI (-ve): 435 (M-1)

### 5 **Example 30**

#### **[4-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**



The product from Example 1 part (e) (300 mg) was dissolved in THF (10 ml) and treated with triethylamine (280  $\mu$ l) followed by 4-chlorobenzeneacetyl chloride (180 mg).

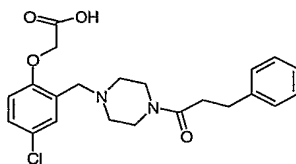
- 10 The reaction mixture was stirred overnight, treated with 1M NaOH (3 ml) and stirred for 3 h. The reaction was acidified with 2M HCl, diluted with ethyl acetate, washed with brine, dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. The residue was purified by RPHPLC to give the title compound (170 mg)

MS: APCI (-ve): 435 (M-1)

- 15  $^1\text{H}$  NMR ( $\text{DMSO-d}_6$ )  $\delta$  7.35 (4H, m), 7.23 (2H, m), 7.06 (1H, d), 4.63 (2H, s), 3.73 (4H, s), 3.56 (4H, m), 2.59 (4H, m)

### **Example 31**

#### **[4-Chloro-2-[[4-(1-oxo-3-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**

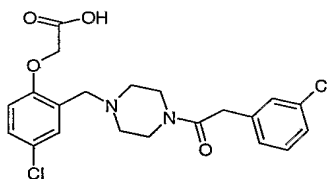


20

The title compound was prepared by the method of Example 30, using the product of example 1 part (e) and benzenepropanoyl chloride.

MS: APCI (-ve): 415 (M-1)

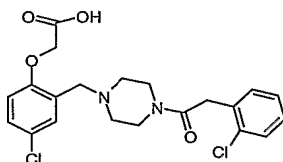
- 25  $^1\text{H}$  NMR ( $\text{DMSO-d}_6$ )  $\delta$  7.38 (1H, m), 7.33 (1H, m), 7.25 (4H, m), 7.18 (1H, m), 7.08 (1H, m), 4.63 (2H, s), 3.74 (2H, s), 3.53 (4H, m), 2.80 (3H, t), 2.63 (3H, t), 2.59 (4H, m)

**Example 32****[3-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

5 The product from Example 11 part (a) (300 mg) was dissolved in DMF (10 ml) and treated with HATU (570 mg), followed by 3-chlorobenzeneacetic acid (190 mg). The reaction mixture was stirred for 18 h, treated with 1M NaOH (3 ml) and stirred for 3 h. The reaction was acidified with 2M HCl, diluted with ethyl acetate, washed with brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. The residue was purified by RPHPLC to give the title  
10 compound (110 mg).

MS: APCI (-ve): 435 (M-1)

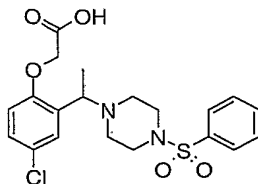
<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.39 (1H, d), 7.31 (4H, m), 7.18 (1H, m), 7.07 (1H, d), 4.65 (2H, s), 3.75 (4H, s), 3.58 (4H, m), 2.62 (4H, m)

**Example 33****[2-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

Prepared using the product of Example 11 part (a) and 2-chlorobenzeneacetic acid by the method of Example 32, to give the title compound.

MS: APCI (-ve): 435 (M-1)

20 <sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.41 (2H, m), 7.30 (4H, m), 7.06 (1H, d), 4.64 (2H, s), 3.82 (2H, s), 3.75 (2H, s), 3.60 (4H, m), 2.64 (4H, m)

**Example 34****[4-chloro-2-[1-[4-(phenylsulfonyl)-1-piperazinyl]ethyl]phenoxy]-acetic acid trifluoroacetate salt**

5

**a) (2-acetyl-4-chlorophenoxy)-acetic acid, 1,1-dimethylethyl ester**

A mixture of 1-(5-chloro-2-hydroxyphenyl)-ethanone (2 g), potassium carbonate (1.62 g) and tert-butylbromoacetate (1.73 ml) in DMF (5 ml) was stirred at ambient temperature for 16 h. Diethyl ether and water were added and the organic layer separated, it was washed with

10 water, aqueous potassium carbonate solution, brine, dried ( $\text{Na}_2\text{SO}_4$ ) and the solvent removed *in vacuo* to give the sub-title compound (2.84 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ): 7.73 (1H, d), 7.38 (1H, dd), 6.77 (1H, d), 4.60 (2H, s), 2.71 (3H, s), 1.49 (9H, s).

**15 b) [4-chloro-2-(1-hydroxyethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester**

To the product of step a) (2.49 g) in methanol (10 ml) at 0 °C was added sodium borohydride (0.33 g) and the reaction warmed to room temperature and stirred for 2 h. Diethyl ether and water were added and the organic layer separated. It was washed with water, brine, dried ( $\text{Na}_2\text{SO}_4$ ) and the solvent removed *in vacuo* to give the sub-title compound (2.40 g).

20  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ): 7.34 (1H, d), 7.17 (1H, dd), 6.68 (1H, d), 5.11 (1H, quintet), 4.58 (1H, d), 4.53 (1H, d), 3.29 (1H, d), 1.53 (3H, d), 1.48 (9H, s).

**c) [4-chloro-2-(1-chloroethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester**

To the product of step b) (0.34 g) in DCM (5 ml) was added Hunigs base (1 ml)

25 followed by methanesulfonyl chloride (0.46 ml) and the reaction stirred at room temperature for 2 h followed by heating at 45°C for 2h. After cooling to 0 °C the bulk of the volatiles were removed *in vacuo*. Diethyl ether and water were added and the organic layer separated.

It was washed with water, sat aqueous sodium bicarbonate solution, dried ( $\text{Na}_2\text{SO}_4$ ) and the solvent removed *in vacuo* to give the sub-title compound as red oil (0.43 g).

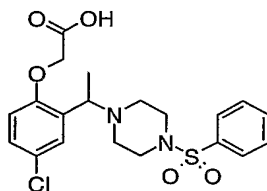
<sup>1</sup>H NMR (CDCl<sub>3</sub>): 7.53 (1H, d), 7.19 (1H, dd), 6.66 (1H, d), 5.60 (1H, q), 4.57 (1H, d), 4.53 (1H, d), 1.80 (3H, d), 1.47 (9H, s).

**d) [4-chloro-2-[1-[4-(phenylsulfonyl)-1-piperazinyl]ethyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

The product of step c) (0.23 g), potassium carbonate (0.14 g), sodium iodide (cat) and 1-(phenylsulfonyl)-piperazine (0.23 g) in DMF (2 ml) were heated at 90 °C for 15h. After cooling to room temperature, diethyl ether and water were added and the organic layer separated. It was purified by passage through SCX resin eluting with MeCN, MeOH followed by 7M NH<sub>3</sub> in MeOH to give the product. Further purification by column chromatography (SiO<sub>2</sub>, 40% diethyl ether in iso-hexane as eluent) gave the sub title product (0.12 g)

MS: APCI (+ve): 495.6 (M+1)

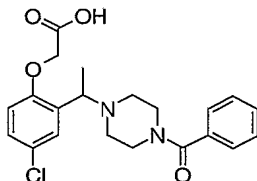
**e) [4-chloro-2-[1-[4-(phenylsulfonyl)-1-piperazinyl]ethyl]phenoxy]-acetic acid trifluoroacetate salt**



The product of step d) (0.12 g) was dissolved in DCM (2 ml) and TFA (2 ml) and the reaction stirred for 64 h; then concentrated *in vacuo* and the resulting solid triturated with diethyl ether and concentrated *in vacuo* to give the sub-title compound as an off white solid (88 mg).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.77 (3H, m), 7.68 (2H, m), 7.42 (2H, m), 7.09 (1H, d), 4.81 (1H, d), 4.77 (1H, d), 4.63 (1H, s), 3.89 - 2.73 (8H, m), 1.52 (3H, d).

MS: APCI (+ve): 437 (M+1)

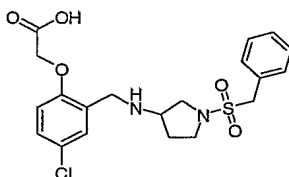
**Example 35****[2-[1-(4-benzoyl-1-piperazinyl)ethyl]-4-chlorophenoxy]-acetic acid, trifluoroacetate salt**

Prepared from the product from Example 34 step c) and 1-benzoyl-piperazine according  
 5 to the methods described in Example 34 steps d) and e) to give the sub-title compound as a  
 white solid (35 mg).

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.54 (1H, d), 7.51 - 7.43 (6H, m), 7.13 (1H, d), 4.84 (2H, s), 4.74  
 (1H, q), 4.19 - 2.86 (8H, m), 1.62 (3H, d).

MS: APCI (-ve): 401 (M-H)

10

**Example 36****[4-chloro-2-[[[1-[(phenylmethyl)sulfonyl]-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid.****a) [1-[(phenylmethyl)sulfonyl]-3-pyrrolidinyl]- carbamic acid, 1,1-dimethylethyl ester**

To a solution/suspension of 3-pyrrolidinyl-carbamic acid, 1,1-dimethylethyl ester (0.5  
 g) and triethylamine (0.38 ml) in dichloromethane (30 ml) at 0 °C was added  
 benzenemethanesulfonyl chloride (0.51 g). The mixture was stirred at 0°C for 30 minutes  
 then stirred at room temperature for 2 days. The reaction was diluted with dichloromethane  
 20 (20 ml) washed with water, saturated aq.  $\text{NaHCO}_3$ (aq), dried( $\text{MgSO}_4$ ) and concentrated *in*  
*vacuo* to give the sub-title compound (0.6 g).

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.39 (5H, m), 7.15 (1H, m), 4.42 (2H, m), 4.00 - 3.92 (1H, m), 3.38  
 (1H, dd), 3.27 (1H, m), 3.15 (1H, m), 3.00 (1H, m), 1.98 (1H, m), 1.74 (1H, m), 1.39 (9H,  
 s).

25

**b) 1-[(phenylmethyl)sulfonyl]- 3-pyrrolidinamine, trifluoroacetic acid salt**

The product of part (a) (0.25 g) was dissolved in dichloromethane (5 ml).  
 Trifluoroacetic acid (5 ml) was added and the mixture stirred at room temperature for 2 h.

The mixture was concentrated *in vacuo* and the residue triturated with ether to give the sub-title compound as a solid (0.23 g).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 8.10 (3H, s), 7.40 (5H, m), 4.49 (2H, s), 3.80 (1H, s), 1.90 (1H, m), 2.17 (1H, m), 3.24 (2H, m), 3.37 (1H, m), 3.48 (1H, m).

5

**c) [4-chloro-2-[[[1-[(phenylmethyl)sulfonyl]-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

To a solution of the product of part (b) (0.22 g) in THF (10ml) and acetic acid (3 ml) was added the product of example 13 part (a) (0.17 g) and 3A molecular sieves. After 30 minutes stirring at room temperature sodium triacetoxyborohydride (0.3 g) was added and the mixture stirred for 24 h. The mixture was concentrated *in vacuo* and the residue dissolved in ethylacetate, washed with NaHCO<sub>3</sub> (aq), brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to give a crude material. Purification by column chromatography (silica, hexane:EtOAc(1:1) as eluent) gave the sub-title compound as an oil (0.15 g).

10 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.45 - 7.32 (5H, m), 7.22 - 7.15 (2H, m), 6.66 (1H, d), 4.53 (2H, d), 4.26 (2H, s), 3.74 (2H, dd), 3.43 - 3.17 (4H, m), 3.06 (1H, dd), 2.04 - 1.93 (1H, m), 1.79 - 1.67 (1H, m), 1.47 (9H, d).

**d) [4-chloro-2-[[[1-[(phenylmethyl)sulfonyl]-3-pyrrolidinyl]amino]methyl] phenoxy]-acetic acid**

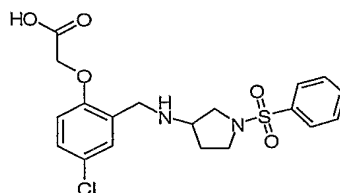
20

To a solution of the product from part (c) (0.15 g) in dichloromethane (3 ml) was added trifluoroacetic acid (3 ml). The mixture was stirred at room temperature for 24 hours. The reaction was concentrated *in vacuo* and the residue triturated with ether to give the title compound as a solid (0.12 g).

25 <sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.51 (1H, d), 7.44 - 7.34 (6H, m), 7.11 (1H, d), 4.76 (2H, s), 4.42 (2H, s), 4.15 (2H, dd), 3.79 (1H, q), 3.60 - 3.52 (1H, m), 3.44 - 3.32 (2H, m), 3.29 - 3.19 (1H, m), 2.32 - 2.20 (1H, m), 2.05 (1H, m).

MS: APCI (-ve): 437 (M-1)

30

**Example 37****[4-chloro-2-[[[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]- acetic acid****a) [1-(phenylsulfonyl)-3-pyrrolidinyl]- carbamic acid, 1,1-dimethylethyl ester**

5 The sub-title compound was prepared by the method of Example 36 part (a) using benzenesulfonyl chloride.

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.83 (2H, dt), 7.65 - 7.60 (1H, m), 7.55 (2H, dt), 4.48 (1H, s), 4.09 (1H, s), 3.46 - 3.32 (2H, m), 3.21 (2H, s), 2.04 (1H, dq), 1.75 (1H, s), 1.41 (9H, s)

10 **b) 1-(phenylsulfonyl)-3-pyrrolidinamine, trifluoroacetic acid salt**

The sub-title compound was prepared by the method of Example 36 part (b) using the product from part (a).

$^1\text{H}$  NMR ( $\text{DMSO}-d_6$ )  $\delta$  8.14 (3H, s), 7.84 - 7.80 (2H, m), 7.76 (1H, m), 7.67 (2H, t), 3.71 (1H, ddd), 3.35 (2H, m), 3.14 (2H, m), 2.05 (1H, m), 1.80 (1H, m).

15

**c) [4-chloro-2-[[[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]- acetic acid, 1,1-dimethylethyl ester**

The sub-title compound was prepared by the method of Example 36 part (c) using the product from part (b).

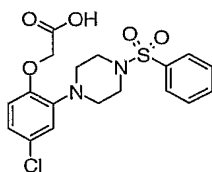
20  $^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.83 (2H, dt), 7.60 - 7.49 (3H, m), 7.15 (1H, dd), 7.11 (1H, d), 6.63 (1H, d), 4.51 (2H, s), 3.68 (2H, s), 3.46 (1H, dd), 3.39 - 3.19 (3H, m), 3.06 (1H, dd), 2.03 - 1.93 (1H, m), 1.72 - 1.62 (1H, m), 1.47 (9H, s).

**d) [4-chloro-2-[[[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]- acetic acid**

25 The title compound was prepared by the method of Example 36 part (d) using the product from part (c).

$^1\text{H}$  NMR ( $\text{DMSO}-d_6$ )  $\delta$  7.80 (2H, m), 7.72 - 7.58 (3H, m), 7.39 (1H, d), 7.34 (1H, dd), 7.05 (1H, d), 4.66 (2H, s), 3.96 (2H, s), 3.59 - 3.28 (3H, m), 3.25 - 3.12 (2H, m), 2.09 (1H, m), 1.88 (1H, m).

30 MS: APCI (-ve): 423 (M-1)

**Example 38****[4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid****5 a) 4-chloro-2-(1-piperazinyl)-phenol**

1-(5-chloro-2-methoxyphenyl)-piperazine hydrochloride (8 g) was heated in a solution of 48% aqueous HBr (200 ml) and the mixture was heated at reflux for 99 hours. The reaction mixture was concentrated *in vacuo*, the sub-title compound was used directly without any further purification.

10 MS: APCI (+ve): 213 (M+1)

**b) 4-[5-chloro-2-(2-ethoxy-2-oxoethoxy)phenyl]-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

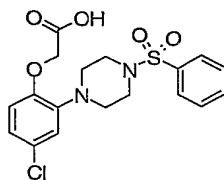
The crude material from part a) was carefully dissolved in aqueous sodiumhydrogen carbonate solution (200 ml), dioxan (80 ml) was added followed by BOC anhydride (10 g). The reaction was stirred for 18 hours, then extracted with ethyl acetate. The organic layer was washed (water), dried (MgSO<sub>4</sub>) then concentrated *in vacuo*. The residue was dissolved in DMF (80 ml) and potassium carbonate was added (10 g), followed by ethyl bromoacetate (1.3 ml). After 2 hours the mixture was partitioned between ethyl acetate/water, the organics separated, dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. The residue was purified by chromatography (silica, (15-20% EtOAc/isohexane as elent)), to give the sub-title compound (6.3g).

MS: APCI (+ve): 399/401 (M+1)

**25 c) [4-chloro-2-(1-piperazinyl)phenoxy]-acetic acid, ethyl ester hydrochloride salt**

The product of part c) (6.3 g), 4M HCl in dioxan (15 ml) and ethanol (30 ml) were stirred at room temperature for 16 hours, then the solid was filtered and washed with ether to give the sub-title compound (5.8 g).

MS: APCI (+ve): 299/301 (M+1)

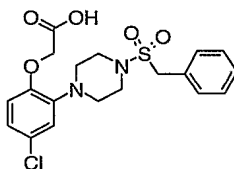
**d) [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid**

To a mixture of the product from step c) (0.34 g) and benzenesulfonyl chloride (0.11 ml) in THF (3 ml) was added triethylamine (0.42 ml) dropwise. After 5 min, further THF (3 ml) was added and the reaction stirred for 16h. It was poured into 2M HCl and extracted with ethyl acetate. The organic layer was separated and washed with sat aqueous sodium bicarbonate solution, brine, dried ( $\text{Na}_2\text{SO}_4$ ) and the solvent removed *in vacuo*. The residue was stirred in THF (2 ml) and 4M NaOH (4 ml) for 16 h. After acidification to pH 3, the aqueous layer was extracted with ethyl acetate. The organic layer was separated and the solvent removed *in vacuo*. Purification by RPHPLC (symmetry column) gave the title product as a white foam (0.12 g).

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.72 (5H, m), 6.91 (1H, dd), 6.83 (1H, d), 6.73 (1H, d), 4.39 (2H, s), 3.11 (4H, m), 3.00 (4H, m).

MS: APCI (-ve): 408 (M-1)

15

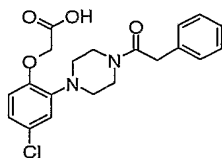
**Example 39****[4-chloro-2-[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]phenoxy]-acetic acid**

Prepared from the product from Example 38 step c) and benzenemethanesulfonyl chloride according to the procedure described in Example 38 step d) to give the sub-title compound as a white solid.

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.45 - 7.34 (5H, m), 6.90 (1H, dd), 6.79 (1H, d), 6.70 (1H, d), 4.46 (2H, s), 4.23 (2H, s), 3.26 (4H, m), 3.07 (4H, m).

MS: APCI (-ve): 423 (M-1)

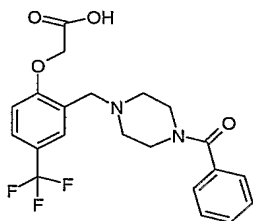
25

**Example 40****[4-chloro-2-[4-(phenylacetyl)-1-piperazinyl]phenoxy]-acetic acid**

Prepared from the product from example 38 step c) and benzeneacetyl chloride by the  
5 method of Example 38 step d) to give the title compound as a white solid.

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.31 (2H, t), 7.25 (2H, d), 7.22 (1H, t), 6.88 (1H, dd), 6.74 (1H, d),  
6.68 (1H, d), 4.19 (2H, s), 4.19 (2H, s), 3.60 (4H, t), 2.96 (4H, s).

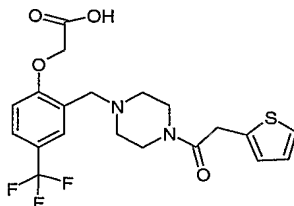
MS: APCI (-ve): 387 (M-1)

**Example 41****[2-[(4-benzoyl-1-piperazinyl)methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**

The title compound was prepared by the method of Example 32 using the product of  
Example 1 part e).

15  $^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.89 (1H, d), 7.63 (1H, dd), 7.47-7.37 (5H, m), 7.17 (1H, d), 4.75  
(2H, s), 3.79 (2H, s), 3.7-3.3 (5H, m), 2.7-2.56 (4H, m).

MS: APCI (-ve): 421 (M-H).

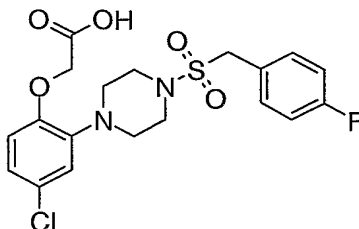
**Example 42****[2-[[4-(2-thienylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**

The title compound was prepared by the method of Example 29 using the product of  
Example 1 part e).

MS: APCI (-ve): 441 (M-H)

### **Example 43**

[4-Chloro-2-[[4-[[[(4-fluorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid



5

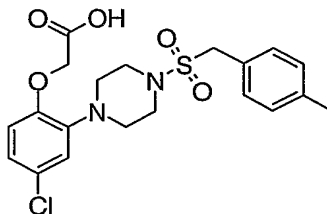
Prepared by the method of example 30, using the product of example 13 part (b) and 4-fluorobenzenemethanesulfonyl chloride to give the title compound.

MS: APCI (+ve): 457 (M+1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.46 (2H, m), 7.35 (1H, d), 7.30 (1H, m), 7.23 (2H, m), 7.01 (1H, d),  
10 4.67 (2H, s), 4.45 (2H, s), 3.66 (2H, s), 3.19 (4H, m), 2.56 (4H, m)

### **Example 44**

**[4-Chloro-2-[[4-[[[(4-methylphenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid**

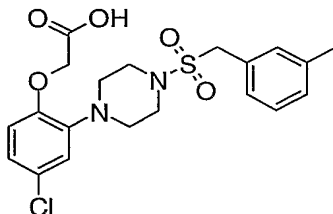


15

Prepared by the method of example 30, using the product of example 13 part (b) and 4-methylbenzenemethanesulfonyl chloride to give the title compound.

MS: APCI (+ve): 453 (M+1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.34 (1H, m), 7.29 (3H, m), 7.18 (2H, m), 7.00 (1H, d), 4.67 (2H, s),  
20 4.37 (2H, s), 3.65 (2H, s), 3.21 - 3.13 (4H, m), 2.58 - 2.50 (4H, m), 2.30 (3H, s)

**Example 45****[4-Chloro-2-[[4-[[[(3-methylphenyl)methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]acetic acid**

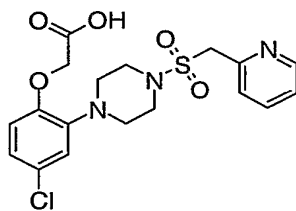
5 The product from example 13 part (b) (350 mg) was dissolved in THF (20 ml) and treated with triethylamine (430  $\mu$ l) followed by 3-methylbenzenesulfonyl chloride (190 mg). The reaction mixture was stirred for 5 h, treated with 1M NaOH (2 ml) and stirred for 20 h. Acetic acid (5 ml) was added, the mixture evaporated *in vacuo*, and the residue dissolved in DMSO and purified by RPHPLC to give the title compound (80 mg)

10 MS: APCI (-ve): 451 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.35 (1H, d), 7.28 (2H, m), 7.19 (3H, m), 7.00 (1H, d), 4.67 (2H, s), 4.38 (2H, s), 3.65 (2H, s), 3.22 - 3.15 (4H, m), 2.58 - 2.52 (4H, m), 2.32 (3H, s)

**Example 46**

15 [4-Chloro-2-[[4-[(2-pyridinylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy] acetic acid



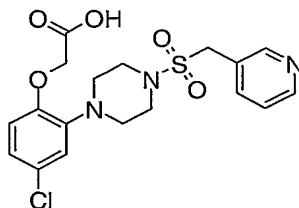
Prepared by the method of example 45, using the product of example 13 part (b) and 2-pyridinemethanesulfonyl chloride to give the title compound.

20 MS: APCI (-ve): 438 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  8.60 (1H, d), 7.89 (1H, t), 7.55 (1H, d), 7.43 (3H, m), 7.08 (1H, d), 4.59 (2H, s), 4.49 (2H, s), 3.42 - 3.33 (4H, m), 3.02 - 2.91 (4H, m).

**Example 47**

[4-Chloro-2-[[4-[(3-pyridinylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy] acetic acid



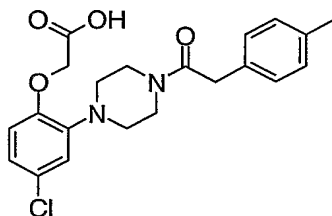
Prepared by the method of example 45, using the product of example 13 part (b) and 3-pyridinemethanesulfonyl chloride to give the title compound.

MS: APCI (-ve): 438 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  8.56 (2H, m), 7.90 (1H, d), 7.49 (3H, m), 7.21 (1H, d), 4.59 (2H, s), 4.57 (2H, s), 3.51 - 3.44 (4H, m), 3.17 - 3.10 (4H, m)

**Example 48**

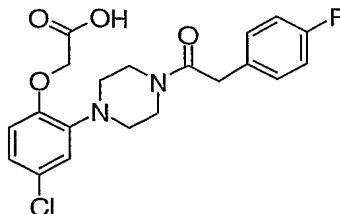
[4-Chloro-2-[[4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl]phenoxy] acetic acid



The product from example 13 part (b) (200 mg) and 4-methylbenzeneacetic acid (63 mg) were dissolved in DMF (3 ml), Hunigs base (0.3 ml) added, followed by EDCI (100 mg). The reaction mixture was stirred for 20 h, diluted with MeOH (3 ml), treated with 1M NaOH (2 ml) and stirred for 20 h. Acetic acid (5 ml) was added, the mixture evaporated *in vacuo*, and the residue dissolved in DMSO and purified by RPHPLC to give the title compound (120 mg).

MS: APCI (-ve): 415 (M-1)

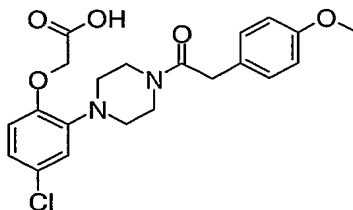
$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.31 (1H, d), 7.23 (1H, dd), 7.09 (5H, m), 6.89 (1H, d), 4.38 (2H, s), 3.64 (2H, s), 3.60 (2H, s), 3.59 - 3.43 (4H, m), 2.51 - 2.41 (4H, m)

**Example 49****[4-Chloro-2-[[4-[(4-fluorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy] acetic acid**

Prepared by the method of example 45, using the product of example 13 part (b) and 4-fluorobenzeneacetyl chloride to give the title compound.

MS: APCI (-ve): 419 (M-1)

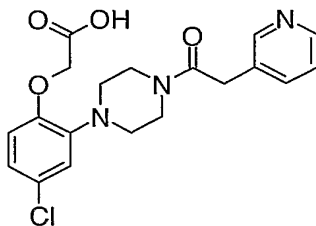
$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.39 (1H, d), 7.33 (1H, dd), 7.24 (2H, m), 7.12 (2H, m), 7.07 (1H, d), 4.63 (2H, s), 3.74 (2H, s), 3.72 (2H, s), 3.62 - 3.52 (4H, m), 2.63 - 2.58 (4H, m)

**Example 50****[4-Chloro-2-[[4-[(4-methoxyphenyl)acetyl]-1-piperazinyl]methyl]phenoxy] acetic acid**

The product from example 13 part (b) (150 mg) and 4-methoxybenzeneacetic acid (60 mg) were dissolved in THF (10 ml), Hunigs base (0.23 ml) added, followed by Pybrop (130 mg). The reaction mixture was stirred for 2 h, treated with 1M NaOH (2 ml) and stirred for 20 h. Concentrated HCl (0.1 ml) added, the mixture evaporated *in vacuo*, and the residue dissolved in DMSO and purified by RPHPLC to give the title compound (110 mg).

MS: APCI (-ve): 431 (M-1)

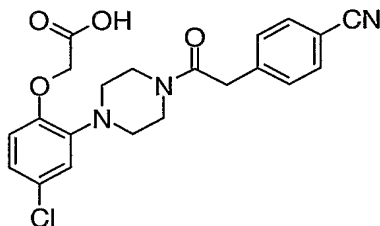
$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.29 (d, 1H), 7.19 (dd, 1H), 7.12 (d, 2H), 6.85 (d, 2H), 6.83 (d, 1H), 4.32 (s, 2H), 3.72 (s, 3H), 3.61 (s, 2H), 3.54 (s, 2H), 3.52 - 3.46 (m, 4H), 2.43 - 2.35 (m, 4H)

**Example 51****[4-Chloro-2-[[4-(3-pyridinylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid**

Prepared by the method of example 50, using the product of example 13 part (b) and 3-pyridineacetic acid to give the title compound.

MS: APCI (-ve): 431 (M-1)

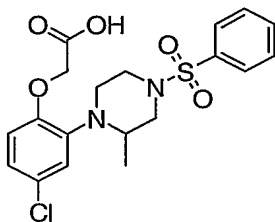
$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.29 (d, 1H), 7.19 (dd, 1H), 7.12 (d, 2H), 6.85 (d, 2H), 6.83 (d, 1H), 4.32 (s, 2H), 3.72 (s, 3H), 3.61 (s, 2H), 3.54 (s, 2H), 3.52 - 3.46 (m, 4H), 2.43 - 2.35 (m, 4H)

**Example 52****[4-Chloro-2-[[4-[(4-cyanophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid**

Prepared by the method of example 50, using the product of example 13 part (b) and 4-cyanobenzeneacetic acid to give the title compound.

MS: APCI (-ve): 426 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.75 (d, 2H), 7.41 (d, 2H), 7.30 (d, 1H), 7.18 (dd, 1H), 6.82 (d, 1H), 4.31 (s, 2H), 3.82 (s, 2H), 3.57 - 3.45 (m, 4H), 3.55 (s, 2H), 2.45 - 2.38 (m, 4H)

**Example 53****[4-Chloro-2-[[2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]acetic acid**

**a) 4-[[5-Chloro-2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]phenyl]methyl]-3-methyl-1-piperazinecarboxylic acid, phenyl ester**

3-Methyl-1-piperazinecarboxylic acid, phenylmethyl ester (380 mg), the product from example 13 part (a) (400 mg) and MgSO<sub>4</sub> were stirred in THF (30 ml) for 20 h. Sodium triacetoxo borohydride (510 mg) was added and stirred for 2 h. The mixture was quenched with water, extracted with EtOAc, washed with water and brine, dried (MgSO<sub>4</sub>), filtered and evaporated *in vacuo*. The residue was purified by chromatography on silica with 20% EtOAc/isohexane as eluent to yield the sub-title compound (500 mg).

MS: APCI (+ve): 490 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.34 (m, 6H), 7.23 (dd, 1H), 6.88 (d, 1H), 5.08 (dd, 2H), 4.68 (s, 2H), 3.80 (m, 1H), 3.66 (m, 1H), 3.34 (m, 2H), 3.21 - 3.08 (m, 1H), 3.05 - 2.81 (m, 1H), 2.65 (m, 1H), 2.46 (m, 1H), 2.14 (m, 1H), 1.41 (s, 9H), 1.03 (d, 3H)

**b) [4-Chloro-2-[(2-methyl-1-piperazinyl)methyl]phenoxy]acetic acid, hydrochloride**

The product from part (a) (500 mg) was dissolved in DCM (10 ml), TFA (5 ml) added and stirred for 20 h, then evaporated *in vacuo*. Concentrated HCl (20 ml) was added and heated at 80°C for 20 h. The mixture was evaporated *in vacuo* and azeotoped with toluene *in vacuo* to yield the sub-title compound (330 mg).

MS: APCI (+ve): 299 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.66 (d, 1H), 7.45 (dd, 1H), 7.10 (d, 1H), 4.82 (s, 2H), 4.63 - 4.40 (m, 2H), 4.29 - 3.96 (m, 1H), 3.77 - 3.11 (m, 4H), 3.46 (s, 2H), 1.46 (d, 2H)

**c) [4-Chloro-2-[[2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid**

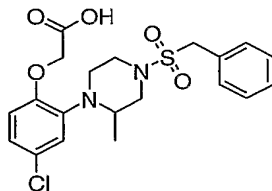
Prepared by the method of example 30, using the product of part (b) and benzenesulfonyl chloride to give the title compound.

MS: APCI (-ve): 437 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.70 (m, 5H), 7.28 (m, 1H), 7.24 (m, 1H), 6.96 (d, 1H), 4.63 (dd, 2H), 3.91 (d, 1H), 3.48 - 3.18 (m, 3H), 2.83 - 2.27 (m, 4H), 1.10 (d, 3H)

**Example 54**

**[4-Chloro-2-[[2-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid**



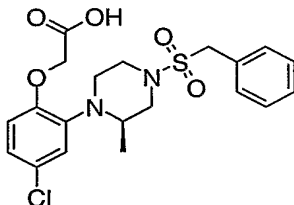
Prepared by the method of example 30, using the product of example 53 part (b) and benzenemethanesulfonyl chloride to give the title compound.

MS: APCI (-ve): 451 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.45 - 7.34 (m, 6H), 7.28 (m, 1H), 7.01 (d, 1H), 4.61 (dd, 2H), 4.44 (s, 2H), 4.00 (d, 1H), 3.48 (d, 1H), 3.54 - 3.23 (m, 3H), 3.11 - 2.24 (m, 4H), 1.12 (d, 3H)

**Example 55**

**[4-Chloro-2-[[2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid**

**a) 3-Methyl-1-[(phenylmethyl)sulfonyl]-(3R)-piperazine**

2-Methyl-(2R)-piperazine (500 mg) was dissolved in DCM (20 ml), triethylamine (3.5 ml) added, followed by benzenemethanesulfonyl chloride (860 mg). The reaction was stirred for 20 h, evaporated *in vacuo* and purified by chromatography on silica with 5% (0.1%  $\text{NH}_3$ -MeOH)/DCM as eluent to give the sub-title compound (230 mg).

MS: APCI (+ve): 255 (M+1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.38 (m, 5H), 4.38 (s, 2H), 3.33 (m, 3H), 2.83 (d, 1H), 2.57 (m, 2H), 2.27 (m, 1H), 0.92 (d, 3H)

**b) [4-Chloro-2-[[ (2R)-2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid**

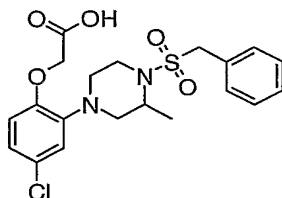
The product from part (a) (200 mg), the product from example 13 part (a) (210 mg) and MgSO<sub>4</sub> were stirred in THF (30 ml) for 20 h. Sodium triacetoxy borohydride (340 mg) was added and stirred for 2 h. The mixture was quenched with water, extracted with EtOAc, washed with water and brine, dried (MgSO<sub>4</sub>), filtered and evaporated *in vacuo*. The residue was dissolved in MeOH (10 ml), 1M NaOH (5ml) added and stirred for 3 h. The mixture was treated with AcOH (5 ml), DMSO (3 ml) added, evaporated to ~ 3 ml and purified by RPHPLC to give the title compound (290 mg).

MS: APCI (+ve): 453 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.38 (m, 6H), 7.28 (dd, 1H), 7.00 (d, 1H), 4.63 (dd, 2H), 4.43 (s, 2H), 3.99 (d, 1H), 3.48 (d, 1H), 3.33 (m, 1H), 3.03 (m, 1H), 2.88 - 2.67 (m, 2H), 2.46 - 2.24 (m, 1H), 1.11 (d, 3H)

**Example 56**

**[4-Chloro-2-[[3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid**



**a) [4-Chloro-2-[(3-methyl-1-piperazinyl)methyl]phenoxy]acetic acid, 1,1-dimethylethyl ester**

2-Methyl-1-piperazine (600 mg), the product from example 13 part (a) (810 mg) and MgSO<sub>4</sub> were stirred in THF (50 ml) for 20 h. Sodium triacetoxy borohydride (2 x 850 mg) was added and stirred for 2 h. The mixture was quenched with water, extracted with EtOAc, washed with water and brine, dried (MgSO<sub>4</sub>), filtered and evaporated *in vacuo*. The residue was purified by chromatography on silica with 20% EtOAc/isohexane as eluent to yield the sub-title compound (850 mg).

MS: APCI (+ve): 355 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.35 (m, 1H), 7.22 (m, 1H), 6.87 (m, 1H), 4.68 (s, 2H), 3.81 (m, 1H), 3.47 (m, 2H), 3.31 (m, 4H), 2.79 (m, 1H), 2.67 (m, 2H), 1.41 (s, 9H), 1.03, 0.90 d, 3H)

**b) [4-Chloro-2-[[3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]acetic acid**

Prepared by the method of example 30, using the product from part (a) and  
5 benzenemethanesulfonyl chloride to give the title compound.

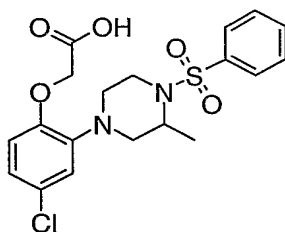
MS: APCI (-ve): 451 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.37 (m, 6H), 7.25 (dd, 1H), 6.93 (d, 1H), 4.67 (s, 2H), 4.39 (dd, 2H),  
3.82 - 3.73 (m, 1H), 3.51 (s, 2H), 3.23 - 3.09 (m, 1H), 2.74 - 2.53 (m, 2H), 2.14 - 1.96 (m,  
3H), 1.24 (d, 3H)

10

**Example 57**

**[4-Chloro-2-[[3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy] acetic acid**



Prepared by the method of example 30, using the product from example 56 part (a) and  
15 benzenesulfonyl chloride to give the title compound.

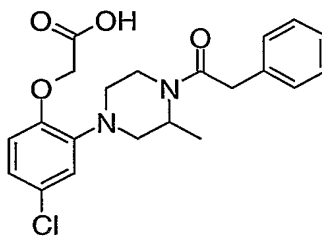
MS: APCI (-ve): 437 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.79 (d, 2H), 7.63 (m, 3H), 7.30 (d, 1H), 7.23 (m, 1H), 6.90 (d 1H),  
4.66 (s, 2H), 3.98 (m, 1H), 3.56 (m, 1H), 3.44 (s, 2H), 3.18 (m, 1H), 2.72 (m, 1H), 2.56 (m,  
1H), 2.03 (m, 1H), 1.94 (m, 1H), 1.09 (d, 3H)

20

**Example 58**

**[4-Chloro-2-[[3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy] acetic acid**



Prepared by the method of example 30, using the product from example 56 part (a) and  
25 benzeneacetyl chloride to give the title compound.

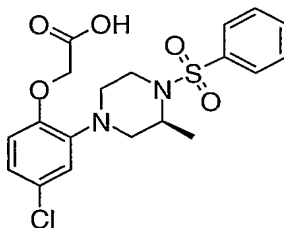
MS: APCI (+ve): 417 (M+1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.58 - 7.40 (m, 2H), 7.30 (m, 2H), 7.26 - 7.16 (m, 3H), 7.08 (m, 1H), 4.79 (s, 2H), 3.73 (s, 2H), 4.91 - 4.66 (m, 1H), 4.53 - 3.88 (m, 3H), 3.78 - 2.88 (m, 3H), 1.16 (d, 3H)

5

### **Example 59**

#### **[4-Chloro-2-[[[(3S)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid**



#### 10 **a) 3-Methyl-4-[(phenylmethyl)sulfonyl]-(3S)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

3-Methyl-(3S)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester (1.0 g) was dissolved in DCM (30 ml) and treated with triethylamine (2.1 ml), followed by benzenesulfonyl chloride (0.77 ml). The reaction mixture was stirred for 20 h, quenched with  
 15 water, extracted with DCM, dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. The residue was purified by chromatography on silica with 25% EtOAc/isohexane as eluent to give the sub-title compound (1.6 g)

MS: APCI (-ve): 341 (M-1)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.81 (m, 2H), 7.54 (m, 3H), 4.18 - 3.58 (m, 4H), 3.16 - 2.68 (m, 3H), 1.43  
 20 (s, 9H), 1.01 (d, 3H)

#### **b) 2-Methyl-1-(phenylsulfonyl)-(2S)-piperazine, trifluoroacetate salt**

The product from part (a) was dissolved in DCM (10 ml), treated with TFA (3 ml) and stirred for 3 h. Toluene (20 ml) was added and the mixture evaporated *in vacuo* to give the  
 25 sub-title compound (1.7 g).

MS: APCI (-ve): 241 (M-1)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.81 (m, 2H), 7.64 (m, 1H), 7.56 (m, 2H), 4.34 (m, 1H), 3.86 (m, 1H), 3.46 (m, 1H), 3.35 (m, 1H), 3.15 (m, 2H), 2.99 (m, 1H), 1.22 (d, 3H)

**c) [4-Chloro-2-[[[(3S)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]-acetic acid**

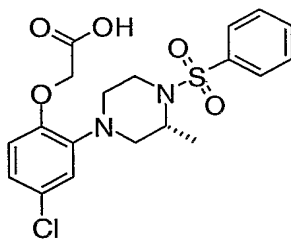
Prepared by the method of example 55 part (b), using the product from part (b) (500 mg) and the product from example 13 part (a) (490 mg) to give the title compound (490 mg).

5 MS: APCI (-ve): 439 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.79 (d, 2H), 7.64 (m, 3H), 7.30 (d, 1H), 7.22 (dd, 1H), 6.90 (d, 1H), 4.65 (s, 2H), 3.98 (m, 1H), 3.56 (m, 1H), 3.43 (s, 2H), 3.18 (m, 1H), 2.72 (m, 1H), 2.55 (m, 1H), 2.03 (m, 1H), 1.93 (m, 1H), 1.09 (d, 1H)

10 **Example 60**

**[4-Chloro-2-[[[(3R)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid**



Prepared by the method of example 59 parts (a) to (c) using 3-methyl-(3R)-1-

15 piperazinecarboxylic acid, 1,1-dimethylethyl ester to give the title compound.

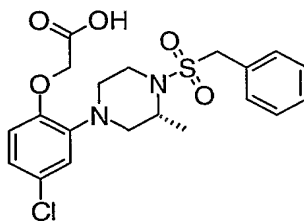
MS: APCI (-ve): 439 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.79 (d, 2H), 7.63 (m, 3H), 7.29 (d, 1H), 7.22 (dd, 1H), 6.89 (d, 1H), 4.63 (s, 2H), 3.98 (m, 1H), 3.56 (m, 1H), 3.43 (s, 2H), 3.18 (m, 1H), 2.72 (m, 1H), 2.55 (m, 1H), 2.03 (m, 1H), 1.93 (m, 1H), 1.09 (d, 3H)

20

**Example 61**

**[4-Chloro-2-[[[(3R)-3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid**



Prepared by the method of example 59 parts (a) to (c) using 3-methyl-(3*R*)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester and benzenemethanesulfonyl chloride to give the title compound.

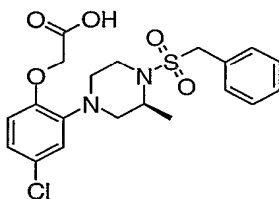
MS: APCI (-ve): 451 (M-1)

- 5  $^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.37 (m, 6H), 7.25 (dd, 1H), 6.94 (d, 1H), 4.69 (s, 2H), 4.39 (dd, 2H), 3.84 - 3.08 (m, 3H), 3.51 (s, 2H), 2.75 - 2.51 (m, 2H), 2.16 - 1.93 (m, 2H), 1.24 (d, 3H)

### **Example 62**

#### **[4-Chloro-2-[[[(3*S*)-3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]**

#### **10 phenoxy]acetic acid**



#### **a) 2-Methyl-4-(1,1-dimethylethyl)-(2*S*)-1,4-piperazinedicarboxylic acid,**

#### **1-(9*H*-fluoren-9-ylmethyl) ester**

- FMOC chloride (500 mg) was added dropwise over 5 min to a vigorously stirred  
 15 mixture of 3-methyl-(3*S*)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester (350 mg) and  $\text{NaHCO}_3$  (840 mg) in DCM (10 ml) and water (10 ml). After 2 h the layers were separated, the organics dried ( $\text{MgSO}_4$ ), filtered and evaporated *in vacuo*. The residue was purified by chromatography on silica with 20% EtOAc/isohexane as eluent to give the sub-title compound (540 mg).

- 20 MS: APCI (+ve): 423 (M+1)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.77 (d, 2H), 7.56 (d, 2H), 7.40 (t, 2H), 7.32 (t, 2H), 4.48 (m, 2H), 4.31 - 3.70 (m, 4H), 4.24 (t, 1H), 3.05 (m, 1H), 3.02 - 2.65 (m, 2H), 1.47 (s, 9H), 1.09 (d, 3H)

#### **b) 2-Methyl-(2*S*)-1-piperazinecarboxylic acid, 9*H*-fluoren-9-ylmethyl ester,**

#### **25 trifluoroacetate salt**

The product from part (a) was dissolved in DCM (5 ml), treated with TFA (2 ml) and stirred for 3 h. Toluene (20 ml) was added and the mixture evaporated *in vacuo* to give the sub-title compound (520 mg).

MS: APCI (+ve): 423 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 9.30 - 9.14 (m, 1H), 8.80 - 8.60 (m, 1H), 7.90 (d, 2H), 7.64 (m, 2H), 7.43 (t, 2H), 7.35 (t, 2H), 4.46 (d, 2H), 4.29 (t, 1H), 4.25 - 4.15 (m, 1H), 3.87 - 3.80 (m, 1H), 3.23 - 2.97 (m, 4H), 2.90 - 2.78 (m, 1H), 1.09 (d, 3H)

5 **c) 4-[[2-(Carboxymethoxy)-5-chlorophenyl]methyl]-2-methyl-(2S)-1-piperazinecarboxylic acid, 1-(9H-fluoren-9-ylmethyl) ester,**

The product from part (b) (500 mg), the product from example 13 part (a) (350 mg) and MgSO<sub>4</sub> were stirred in THF (50 ml) for 20 h. Sodium triacetoxymethylborohydride (480 mg) was added and stirred for 2 h. The mixture was quenched with water, extracted with EtOAc, washed with water and brine, dried (MgSO<sub>4</sub>), filtered and evaporated *in vacuo*. The residue was purified by chromatography on silica with 20% EtOAc/isohexane as eluent to yield the sub-title compound (510 mg).

MS: APCI (+ve): 578 (M+1)

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.76 (d, 2H), 7.57 (d, 2H), 7.44 (d, 1H), 7.39 (t, 2H), 7.31 (t, 2H), 7.15 (dd, 1H), 6.65 (d, 1H), 4.50 (s, 2H), 4.43 (m, 2H), 4.28 - 4.17 (m, 1H), 4.24 (t, 1H), 3.90 - 3.81 (m, 1H), 3.56 (s, 2H), 3.19 (m, 1H), 2.80 (d, 1H), 2.65 (d, 1H), 2.23 (dd, 1H), 2.10 (td, 1H), 1.48 (s, 9H), 1.27 (d, 1H)

**d) [4-Chloro-2-[[[(3S)-3-methyl-1-piperazinyl]methyl]phenoxy]acetic acid**

20 The product from part (c) (500 mg) was dissolved in DCM (5 ml), pyrrolidine (1.0 ml) added and stirred for 20 h. Toluene added and evaporated *in vacuo*. Purified by chromatography on silica with 5 - 10% (0.1% NH<sub>3</sub>-MeOH)/DCM as eluent to give the sub-title compound (300 mg).

MS: APCI (+ve): 355 (M+1)

25 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.36 (d, 1H), 7.15 (dd, 1H), 6.65 (d, 1H), 4.50 (s, 2H), 3.59 (s, 2H), 3.11 - 2.94 (m, 3H), 2.84 (m, 2H), 2.29 (m, 1H), 1.99 (m, 1H), 1.47 (s, 9H), 1.17 (d, 3H)

**e) [4-Chloro-2-[[[(3S)-3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]acetic acid**

30 Benzenemethanesulfonyl chloride (100 mg) was added dropwise over 5 min to a vigorously stirred mixture of the product from part d) (150 mg) and NaHCO<sub>3</sub> (110 mg) in DCM (10 ml) and water (10 ml). After 2 h the layers were separated, the organics dried

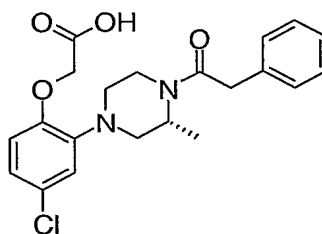
(MgSO<sub>4</sub>), filtered and evaporated *in vacuo*. The residue was purified by RVHPLC to give the title compound (140 mg).

MS: APCI (-ve): 451 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.43 - 7.32 (m, 6H), 7.23 (dd, 1H), 6.90 (d, 1H), 4.61 (s, 2H), 4.39 (dd, 2H), 3.77 (m, 1H), 3.50 (s, 2H), 3.30 (m, 1H), 3.14 (m, 1H), 2.71 (m, 1H), 2.56 (m, 1H), 2.10 (m, 1H), 2.00 (m, 1H), 1.24 (d, 3H)

### Example 63

#### [4-Chloro-2-[[[(3R)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid



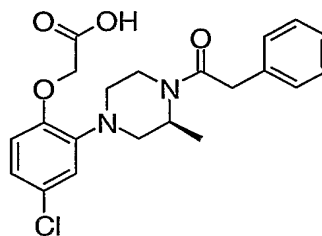
Prepared by the method of example 59 parts (a) to (c) using 3-methyl-(3R)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester and benzeneacetyl chloride to give the title compound (130 mg).

MS: APCI (-ve): 415 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.35 (d, 1H), 7.30 (m, 2H), 7.21 (m, 4H), 6.87 (d, 1H), 4.54 (m, 1H), 4.51 (s, 2H), 4.20 (m, 1H), 3.80 - 2.62 (m, 3H), 3.68 (s, 2H), 3.50 (s, 2H), 2.07 (m, 1H), 1.94 (m, 1H), 1.17 (d, 3H)

### Example 64

#### [4-Chloro-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid



#### a) 3-Methyl-4-(phenylacetyl)-(3S)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester

3-Methyl-(3S)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester (250 mg), benzeneacetic acid (210 mg) and Hunigs base (450 μl) were dissolved in DMF (10 ml) and

HATU (720 mg) added portionwise over 2 min. The reaction mixture was stirred for 3 h, diluted with EtOAc, washed with water and brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. The residue was purified by chromatography on silica with 25% EtOAc/isohexane as eluent to give the sub-title compound (330 mg)

5 MS: APCI (+ve): 319 (M+1)

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.27 (m, 5H), 4.87 - 4.38 (m, 1H), 4.18 - 3.49 (m, 3H), 3.74 (s, 2H), 3.26 - 2.49 (m, 4H), 1.44 (s, 9H), 1.11 (m, 3H)

**b) 2-Methyl-1-(phenylacetyl)-(2S)- piperazine, trifluoroacetate salt**

10 The product from part (a) was dissolved in DCM (10 ml), treated with TFA (3 ml) and stirred for 3 h. Toluene (20 ml) was added and the mixture evaporated *in vacuo* to give the sub-title compound (330 mg).

MS: APCI (+ve): 219 (M+1)

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.28 (m, 5H), 5.27 - 4.20 (m, 3H), 4.86 (s, 2H), 3.57 - 2.45 (m, 4H), 1.30  
15 (d, 3H)

**c) [4-Chloro-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid**

Prepared by the method of example 55 part (b), using the product from part (b) (300  
20 mg) and the product from example 13 part a) (300 mg) to give the title compound (400 mg).

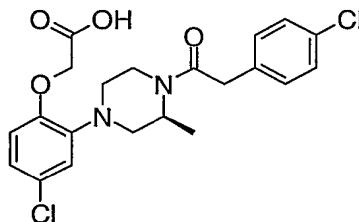
MS: APCI (-ve): 415 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.37 (d, 1H), 7.30 (m, 2H), 7.23 (m, 4H), 6.92 (d, 1H), 4.65 (s, 2H), 4.57 (m, 1H), 4.21 (m, 1H), 3.79 - 2.64 (m, 3H), 3.68 (s, 2H), 3.52 (s, 2H), 2.09 (m, 1H), 1.95 (m, 1H), 1.17 (d, 3H)

25

**Example 65**

**[4-Chloro-2-[[[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl] phenoxy]acetic acid**



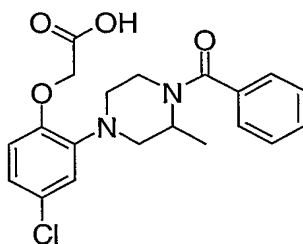
Prepared by the method of example 62 part (e) using the product from example 62 part (d) and 4-chlorobenzeneacetyl chloride to give the title compound.

MS: APCI (-ve): 449 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.40 - 7.32 (m, 3H), 7.28 - 7.19 (m, 3H), 6.93 (d, 1H), 4.65 (s, 2H),  
5 4.54 (m, 1H), 4.20 (m, 1H), 3.69 (s, 2H), 3.53 (s, 2H), 3.24 (m, 1H), 2.84 (m, 1H), 2.69 (m,  
1H), 2.12 (m, 1H), 1.98 (m, 1H), 1.19 (m, 3H)

### Example 66

#### [2-[(4-Benzoyl-3-methyl-1-piperazinyl)methyl]-4-chlorophenoxy]acetic acid



10

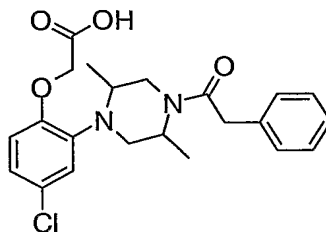
Prepared by the method of example 30, using the product from example 56 part (a) and benzoyl chloride to give the title compound.

MS: APCI (-ve): 401 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.44 (m, 3H), 7.36 (m, 3H), 7.22 (dd, 1H), 6.88 (d, 1H), 4.56 (s, 2H),  
15 3.54 (s, 2H), 3.49 - 3.10 (m, 3H), 2.89 - 2.65 (m, 2H), 2.24 - 2.03 (m, 2H), 1.30 (d, 3H)

### Example 67

#### [4-chloro-2-[[2,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid



#### a) 2,5-dimethyl-1-(phenylacetyl)-piperazine

Diisopropylethylamine (0.38 ml) was added to a solution of *trans*-2,5-dimethyl-piperazine (1.50 g), phenyl acetic acid (0.59 g) and HATU (1.55 g) in DMF (10 ml). The reaction mixture was stirred overnight at ambient temperature. The solution was diluted with water, then extracted with ethyl acetate. The organic extracts were dried (MgSO<sub>4</sub>) then  
25 concentrated *in vacuo* to give the sub-title compound (1.8 g).

MS: APCI (+ve): 233 (M+1)

**b) [4-chloro-2-[[2,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

The product from step a)(370 mg) was dissolved in THF (50 ml) and the product from  
5 example 13 part a) (430 mg) was added followed by MgSO<sub>4</sub> and the suspension was stirred  
for 3h under nitrogen. Sodium triacetoxyborohydride (340 mg) was added and stirred  
overnight. The reaction mixture was diluted with water and extracted with EtOAc. The  
organic phase was dried (MgSO<sub>4</sub>) then concentrated *in vacuo*.

The residue was purified by chromatography on silica with 50% diethyl ether/isohexane as  
10 eluent to give the sub-title compound (240 mg).

MS: APCI (+ve): 487 (M+1)

**c) [4-chloro-2-[[2,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**

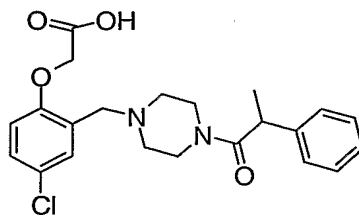
The product from part b) (0.24 g), TFA (5 ml) and dichloromethane (10 ml) were stirred  
15 for 16 h at ambient temperature. The solution was concentrated *in vacuo* and purified to  
reverse phase HPLC to give the title compound (40 mg).

MS: APCI (+ve): 431 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.39 (1H, s), 7.29-7.16 (6H, m), 6.90 (1H, d), 4.59 (2H, s), 4.37 (1H,  
s), 3.8 (1H, d), 3.73-3.49 (4H, dd), 3.24 (1H, d), 2.95 (1H, s), 2.7-2.26 (2H, dd), 1.15 (3H, d),  
20 0.87 (3H, d).

**Example 68**

**[4-Chloro-2-[[4-(1-oxo-2-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**



25 a) 4-(1-Methyl-2-oxo-2-phenylethyl)-1-piperazinecarboxylic acid, 1,1-dimethylethyl  
ester

To *N*-BOC-piperazine (0.373 g) in DMF (10 ml) was added HATU (1.14 g) followed by 2-  
phenylpropionic acid (0.30 ml) and the reaction stirred at RT for 16 h followed by 60 °C for 1  
h. The reaction was cooled to RT, then diluted with diethyl ether, washed with water (x3),

2M HCl (x2), saturated aq. NaHCO<sub>3</sub> (aq) (x 2), dried (Na<sub>2</sub>SO<sub>4</sub>) and concentrated *in vacuo* to give the sub-titled compound (0.25 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.49 - 7.22 (5H, m), 3.85 (1H, q), 3.82 (1H, m), 3.66 - 3.14 (6H, m), 2.70 (1H, m), 1.45 (3H, d), 1.42 (9H, s).

5

**b) [4-Chloro-2-[[4-(1-oxo-2-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**

The product of example 68 part a) (250 mg) was dissolved in DCM (5 ml) and TFA (5 ml) and stirred for 1 h, and then the reaction mixture was concentrated *in vacuo*. The residue was dissolved in THF (5 ml), the product from example 13 part b (179 mg) and MgSO<sub>4</sub> (xs)

10 added and the reaction stirred for 1 h. Sodium triacetoxymethylborohydride (0.62 g) was added and the reaction stirred for 16 h. The reaction was quenched with water and extracted with ethyl acetate. The organic layer was dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. It was purified by passage through SCX resin eluting with MeCN, MeOH followed by 7M NH<sub>3</sub> in MeOH.

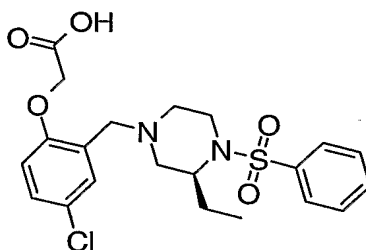
Treatment with TFA (10 ml) for 16 h and purification by RPHPLC to give the title compound  
15 as a white foam (0.103 g)

MS: APCI (+ve): 417 (M+1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) 7.34-7.19 (7H, m), 6.94 (1H, d), 4.47 (2H, s), 4.09 (1H, q), 3.57 (2H, s), 3.55 (4H, m), 3.29 (1H, m), 2.44 (2H, m), 2.09 (1H, m), 1.27 (3H, d).

20 **Example 69**

**[4-Chloro-2-[[4-(1-oxo-2-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**



**a) (3S)-3-Ethyl-1-(phenylmethyl)-2,5-piperazinedione**

To a solution of DCC (5.07 g) in DCM (140 mL) at 0 °C was added *N*-BOC-L- $\alpha$ -  
25 aminobutyric acid (5 g) followed by ethyl *N*-benzylglycinate (4.6 mL) dropwise. The resulting solution was stirred at 0 °C for 2 h and RT 1 h, filtered and the concentrated to give an oil. This was dissolved in DCM (100 mL) and TFA (100 ml) and stirred for 1 h. The solution was concentrated under reduced pressure. The residue was stirred in saturated aq

NaHCO<sub>3</sub> (125 ml) and EtOAc (125 ml) for 6 h. The organics were separated, dried (Na<sub>2</sub>SO<sub>4</sub>), and concentrated to give the sub title compound as a white solid. (5.68 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.37 - 7.31 (3H, m), 7.26 (2H, m), 6.80 (1H, s), 4.70 (1H, d), 4.50 (1H, d), 4.05 (1H, s), 3.87 (1H, d), 3.80 (1H, d), 1.93 (2H, m), 0.98 (3H, t).

5

**b) (3S)-3-Ethyl-1-(phenylmethyl)-piperazine**

To a solution of the product of example 69 part a) (5.68 g) in THF (30 ml) at 0 °C was added LAH (100 ml, 1.0M in THF) dropwise. The resulting solution was heated at reflux overnight. The reaction mixture was cooled to RT and quenched by cautious sequential  
10 addition of water (3.8 ml), 15% aq NaOH (3.8 ml), and water (11.4 ml). The precipitous solution was diluted with EtOAc and filtered through Celite. The residue was washed with EtOAc (3 x 100 ml) and the combined organics concentrated *in vacuo*. The crude product was dissolved in DCM, filtered through Celite and the solvent removed in vacuo to give the sub-titled product as a yellow oil (4.74 g).

15 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.41 - 7.19 (5H, m), 3.53 (1H, d), 3.46 (1H, d), 2.99 - 2.61 (5H, m), 2.01 (1H, dt), 1.69 (1H, t), 1.35 (2H, dq), 0.90 (3H, t).

**c) (2S)-2-Ethyl-4-(phenylmethyl)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

To a solution of the product from example 69 part b) (4.74 g) in DCM (150 ml) was  
20 added (BOC)<sub>2</sub>O (5.52 g) and the reaction stirred at RT for 48 h.. The reaction was concentrated under reduced pressure. The crude product was purified by chromatography (silica, (0-10% EtOAc/isohehexane as eluent)), to give the sub-titled compound as a colourless oil (6.09g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.33 - 7.22 (5H, m), 3.89 (2H, m), 3.53 (1H, d), 3.38 (1H, d), 3.04 (1H, t),  
25 2.71 (2H, dd), 2.02 (2H, ddd), 1.83 (1H, m), 1.64 (1H, m), 1.45 (9H, s), 0.80 (3H, t).

**d) (2S)-2-Ethyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

A solution of the product from example 69 part c) (6.09 g) and 10% Pd/C (1.14 g) in EtOH (85 mL) was hydrogenated at 3.8 bar for 16 h. The reaction mixture was filtered  
30 through Celite and the filtrate concentrated *in vacuo* to give the sub-title compound as an oil (3.65 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 3.87 (2H, m), 2.87 (4H, m), 2.68 (1H, td), 1.76 (1H, m), 1.59 (1H, m), 1.46 (9H, s), 0.89 (3H, t).

**e) (2S)-4-[[5-chloro-2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]phenyl]methyl]-2-ethyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

The product from example 69 part d) (1 g), the product from example 13 part b) (1.263 g) and MgSO<sub>4</sub> (xs) were stirred in THF (50 ml) for 16 h. Sodium triacetoxy borohydride (3.96 g) was added and the reaction stirred for 16 h. The reaction was quenched with water and extracted with ethyl acetate. The organic layer was dried (Na<sub>2</sub>SO<sub>4</sub>) and concentrated *in vacuo*. It was purified by chromatography (silica, (20% EtOAc/isohexane as eluent)), to give the sub-titled compound as a colourless oil (2.03 g).

MS: APCI (+ve): 469 (M+1)

**f) [4-Chloro-2-[[[(3S)-3-ethyl-1-piperazinyl]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester trifluoroacetate salt**

To a solution of the product from example 69 part e) (2 g) in dichloromethane (100 ml) was added trifluoroacetic acid (100 ml). The mixture was stirred at RT for 24 h. Toluene (100 ml) was added and reaction was concentrated (bath temp <40 °C) *in vacuo* to give the sub-titled compound as a yellow oil (3.10 g).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.55 (1H, d), 7.44 (1H, m), 7.06 (1H, d), 4.80 (2H, m), 4.17 (2H, m), 3.65 - 3.07 (5H, m), 2.95 (1H, m), 2.77 (1H, m), 1.61 (2H, m), 1.44 (9H, s), 0.92 (3H, t).

**g) [4-Chloro-2-[[[(3S)-3-ethyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**

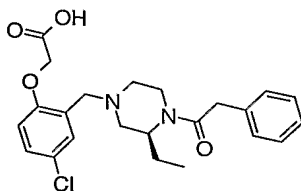
To a vigorously stirred solution / suspension of the product from example 69 part f) (0.393 g) and solid sodium bicarbonate (0.342 g) in DCM (3 ml) and water (3 ml) was added benzenesulfonyl chloride (0.21 ml) dropwise. The mixture was stirred for 16 h. The organic layer and 1 further DCM extract were combined and purified by passage through SCX resin eluting with MeCN, MeOH followed by 7M NH<sub>3</sub> in MeOH. The basic fractions were concentrated *in vacuo*, dissolved in DCM (3 ml) and treated with TFA (20 ml) for 16 h. Concentration *in vacuo* and purification by RPHPLC gave the title product as a white foam (45 mg).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ (90 °C) 7.81 (2H, d), 7.66 (1H, t), 7.59 (2H, t), 7.24 (1H, d), 7.18 (1H, dd), 6.81 (1H, d), 4.45 (2H, s), 3.73 (1H, m), 3.64 (1H, d), 3.33 (2H, s), 3.19 (1H, m), 2.61 (2H, d), 1.74 (2H, dt), 1.69 (1H, q), 1.62 (1H, q), 0.78 (3H, t).

MS: APCI (-ve): 451 (M-H).

### **Example 70**

#### **[4-chloro-2-[[[(3S)-3-ethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**



5

Prepared from the product from example 69 part f) and phenylacetyl chloride according to the procedure described in example 69 part g) to give the title compound as a white solid (30 mg).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.34 - 7.19 (7H, m), 6.86 (1H, d), 4.50 (2H, s), 3.48 (2H, s), 4.39 - 3.12 (5H, m), 2.78 (2H, q), 1.94 (2H, m), 1.82 - 1.56 (2H, m), 0.73 (3H, t).

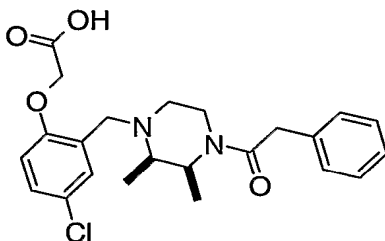
10

MS: APCI (-ve): 429 (M-H).

### **Example 71**

#### **(Cis)-[4-chloro-2-[[2,3-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**

15



#### **a) [4-Chloro-2-[(2,3-dimethyl-1-piperazinyl)methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

(*cis*)-2,3-Dimethylpiperazine (0.115 g), the product from example 13 part b) (0.260 g) and MgSO<sub>4</sub> (1 g) were stirred in THF (3 ml) for 2 h. Sodium triacetoxy borohydride (0.65 g) was added and the reaction stirred for 16 h. The reaction was quenched with water and extracted with ethyl acetate. The organic layer was dried (Na<sub>2</sub>SO<sub>4</sub>) and concentrated *in vacuo*. It was purified by passage through SCX resin eluting with MeCN, MeOH followed by 7M NH<sub>3</sub> in MeOH. The basic fractions were concentrated *in vacuo* to give the sub-titled product as a yellow oil (0.188 g).

25

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.39 (1H, s), 7.21 (1H, d), 6.87 (1H, d), 4.68 (2H, s), 3.53 (4H, m), 3.08 - 2.33 (3H, m), 2.23 (1H, m), 1.41 (9H, s), 1.00 (3H, d), 0.91 (3H, m).

**b) (Cis)-[4-chloro-2-[[2,3-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic acid, 1,1-dimethylethyl ester**

To a vigorously stirred solution / suspension of the product from example 71 part a) (0.189 g) and solid sodium bicarbonate (0.215 g) in DCM (2 ml) and water (2 ml) was added phenylacetyl chloride (0.14 ml) dropwise. The mixture was stirred for 2 h. The organic layer and 1 further DCM extract were combined, dried ( $\text{Na}_2\text{SO}_4$ ) and purified by passage through SCX resin eluting with MeCN, MeOH followed by 7M  $\text{NH}_3$  in MeOH. The basic fractions were concentrated *in vacuo* to give the sub-titled product as a white foam (0.205 g). MS: APCI (+ve): 487 (M+H).

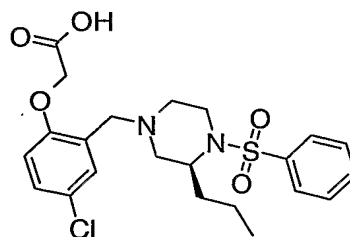
**c) (Cis)-[4-chloro-2-[[2,3-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-**

**acetic acid**

The product from example 71 part b) treated with TFA (10 ml) for 16 h. Concentration *in vacuo* and purification by RPHPLC gave the title product as a white foam (39 mg).  $^1\text{H}$  NMR (DMSO- $d_6$ ) (90 °C)  $\delta$  7.37 (1H, d), 7.31 - 7.16 (6H, m), 6.90 (1H, d), 4.55 (2H, s), 4.21 (1H, bs), 3.89 (2H, d), 3.70 (1H, d), 3.64 (1H, d), 3.19 (1H, d), 2.99 (1H, bs), 2.69 (1H, d), 2.38 (1H, m), 2.00 (1H, td), 1.09 (3H, d), 1.03 (3H, d). MS: APCI (-ve): 429 (M-H).

**Example 72**

**[4-chloro-2-[(3S)-4-(phenylsulfonyl)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid**



**a) (3S)-1-(Phenylmethyl)-3-propyl-2,5-piperazinedione**

Prepared from *N*-BOC-L-norvaline (2.5 g) according to the procedure described in example 69 part a) for the ethyl analogue to give the sub-titled compound as a white solid (2.42 g).

5 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.33 (3H, m), 7.25 (2H, m), 7.16 (1H, s), 4.66 (1H, d), 4.53 (1H, d), 4.06 (1H, td), 3.86 (1H, d), 3.79 (1H, d), 1.85 (2H, m), 1.42 (2H, sextet), 0.95 (3H, t).

**b) (3S)-1-(Phenylmethyl)-3-propyl-piperazine**

10 Prepared from example 72 part a) (2.4 g) according to the procedure described in example 69 part b) for the ethyl analogue to give the sub-titled compound as a yellow oil (1.81 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.33 - 7.22 (5H, m), 3.52 (1H, d), 3.46 (1H, d), 2.95 (1H, dt), 2.89 (1H, td), 2.76 (2H, m), 2.00 (1H, td), 1.70 (1H, t), 1.42 - 1.26 (5H, m), 0.89 (3H, t).

15 **c) (2S)-4-(Phenylmethyl)-2-propyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

Prepared from example 72 part b) (1.8 g) according to the procedure described in example 69 part c) for the ethyl analogue to give the sub-titled compound as a colourless oil (1.95 g).

20 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.32 - 7.21 (5H, m), 4.02 (1H, s), 3.86 (1H, d), 3.53 (1H, d), 3.38 (1H, d), 3.05 (1H, td), 2.74 (1H, d), 2.66 (1H, d), 2.06 (1H, dd), 2.01 (1H, td), 1.76 (1H, m), 1.60 (1H, m), 1.21 (2H, sextet), 0.91 (3H, t).

**d) (2S)-2-Propyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

25 Prepared from example 72 part c) (1.9 g) according to the procedure described in example 69 part d) for the ethyl analogue to give the sub-titled compound as a dark oil (1.38 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 4.01 (1H, s), 3.84 (1H, d), 2.93 (2H, t), 2.84 (2H, d), 2.67 (1H, td), 1.73 (1H, m), 1.56 (1H, m), 1.46 (9H, s), 1.29 (2H, m), 0.94 (3H, t).

**e) (2S)-4-[[5-chloro-2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]phenyl]methyl]-2-propyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

Prepared from example 72 part d) (0.68 g) and the product from example 13 part b) (0.812 g) according to the procedure described in example 69 part e) for the ethyl analogue to give the sub-titled compound as a white oily solid (1.43 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.43 (1H, d), 7.13 (1H, dd), 6.64 (1H, d), 4.49 (2H, s), 4.04 (1H, s), 3.88 (1H, d), 3.54 (2H, s), 3.08 (1H, t), 2.74 (2H, t), 2.14 (2H, dt), 1.73 (3H, m), 1.47 (9H, s), 1.45 (9H, s), 1.27 (1H, m), 0.94 (3H, t).

**f) [4-Chloro-2-[[[(3S)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester trifluoroacetate salt**

Prepared from example 72 part e) (1.43 g) according to the procedure described in example 69 part f) for the ethyl analogue to give the sub-titled compound as a yellow oil (1.43 g).

MS: APCI (+ve): 327 ( $\text{M}+\text{H}-t\text{Bu}$ ).

**g) [4-Chloro-2-[[[(3S)-4-(phenylsulfonyl)-3-propyl-1-piperazinyl] methyl]phenoxy]-acetic acid**

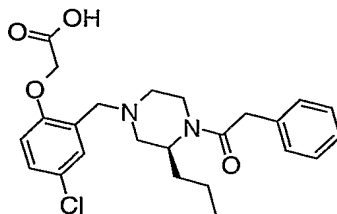
Prepared from example 72 part f) (0.70 g) and benzenesulfonyl chloride according to the procedure described in example 69 part g) for the ethyl analogue to give the title compound as a white solid (0.154 g).

$^1\text{H}$  NMR ( $\text{DMSO}-d_6$ )  $\delta$  7.80 (2H, m), 7.66 (1H, m), 7.59 (2H, m), 7.25 (1H, d), 7.20 (1H, dd), 6.85 (1H, d), 4.55 (2H, s), 3.81 (1H, s), 3.63 (1H, d), 3.35 (2H, s), 3.19 (1H, dt), 2.61 (2H, m), 1.75 (2H, m), 1.65 (1H, m), 1.52 (1H, m), 1.18 (2H, m), 0.84 (3H, t).

MS: APCI (+ve): 467 ( $\text{M}+\text{H}$ ).

**Example 73**

**[4-Chloro-2-[[[(3S)-4-(phenylacetyl)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid**



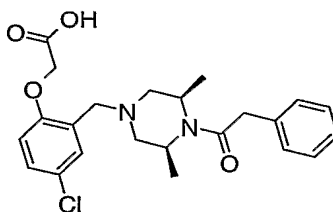
Prepared from the product from example 72 part (f) (0.70 g) and phenylacetyl chloride according to the procedure described in example 69 part (g) to give the title compound as a white solid (214 mg).

$^1\text{H}$  NMR (DMSO- $d_6$ ) (90 °C)  $\delta$  7.36 - 7.12 (7H, m), 6.88 (1H, d), 4.48 (2H, s), 3.70 (1H, d), 3.64 (1H, d), 3.48 (2H, s), 3.06 (1H, s), 2.75 (2H, m), 1.96 (2H, m), 1.73 (1H, s), 1.55 (1H, s), 1.15 (2H, m), 0.85 (3H, t).

MS: APCI (+ve): 445 (M+H).

#### **Example 74**

##### **10 [4-chloro-2-[[[(3R,5S)-3,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic acid**



##### **a) (3R,5S)-3,5-dimethyl-4-(phenylacetyl)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

15 Prepared by the method of example 67 part (a) using (3R,5S)-3,5-dimethyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester and phenyl acetyl chloride to give the sub-title compound.

MS: ESI (+ve): 333 (M+H).

##### **20 b) (2R,6S)- 2,6-dimethyl-1-(phenylacetyl)-piperazine**

TFA (10 ml) was added to a solution of the product from part a) (2.25 g) in DCM (20 ml), and stirred for 18 h, then evaporated *in vacuo*. The residue was triturated with ether, filtered to give the sub-title compound (700 mg).

MS: ESI (+ve): 233 (M+H).

25

##### **c) [4-chloro-2-[[[(3R,5S)-3,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic acid, 1,1-dimethylethyl ester**

Triethylamine (0.25 ml) was added to a mixture of the product from example 13 part b) (500 mg), and the product from part b) (700 mg) in 1,2-dichloroethane (10 ml). After 1 h sodium triacetoxyborohydride (530 mg) was added and the reaction stirred for a further 20 h.

30

The mixture was partitioned between EtOAc and aqueous NaHCO<sub>3</sub>. The organic phase was separated and washed with water, dried (MgSO<sub>4</sub>) and evaporated in vacuo. The residue was purified by chromatography on silica with 20% EtOAc/isohexane as eluent to yield the sub-title compound (600 mg).

5 MS: ESI (+ve): 489 (M+H).

**d) [4-chloro-2-[[[(3R,5S)-3,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic acid**

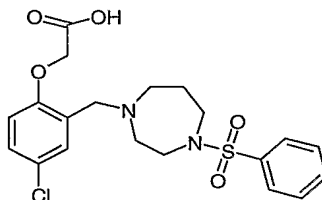
The title compound was prepared by the method of example 67 part (c) using the  
10 product from part (c).

MS: ESI (-ve): 429 (M-H).

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.64 (1H, s), 7.37 (1H, d), 7.3-7.18 (5H, m), 7.04 (1H, d), 4.74 (2H, s), 4.5 (2H, s), 4.07 (2H, s), 3.71 (2H, s), 3.1 (2H, d), 2.76 (2H, s), 1.31 (6H, d).

15 **Example 75**

**[4-chloro-2-[[hexahydro-4-(phenylsulfonyl)-1H-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid**



20 **a) 1H-1,4-diazepine-1-carboxylic acid, 4-[[5-chloro-2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]phenyl]methyl]hexahydro-1,1-dimethylethyl ester**

A solution of the product from example 13 part a), *N*-(*tert*-butoxycarbonyl) homopiperazine (0.74 g) and MgSO<sub>4</sub> (2 g) in dry tetrahydrofuran (20 ml) was stirred at room temperature for 20 h. Sodium triacetoxyborohydride (2.35 g) was added portionwise over 4 h  
25 and the reaction mixture quenched with water, extracted with ethyl acetate (x3), washed with brine (x1), dried (MgSO<sub>4</sub>), filtered and concentrated *in vacuo*. Purification by column chromatography (gradient of 20-100% EtOAc in isohexane) gave the sub-title compound as a white solid (1.01 g).

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 7.44 (1H, d), 7.14 (1H, dd), 6.64 (1H, d), 4.49 (2H, s), 3.72 (2H, s), 3.57 - 3.41 (4H, m), 2.76 - 2.62 (4H, m), 1.93 - 1.71 (2H, m), 1.48 (9H, s), 1.47 (9H, s).

5 **b) [4-Chloro-2-[(hexahydro-1H-1,4-diazepin-1-yl)methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

Trifluoroacetic acid (20 ml) was added to a stirred solution of the product of step (a) (1.01 g) in DCM (80 ml). The reaction mixture was stirred for 3 h, diluted with toluene (50 ml) and concentrated *in vacuo* to give a yellow oil (1.67 g) which was used directly in the  
10 next step without further purification.

<sup>1</sup>H NMR (300 MHz, DMSO-d<sub>6</sub>) δ 7.62 (1H, d), 7.51 (1H, dd), 7.11 (1H, d), 4.81 (2H, s), 4.18 (2H, s), 3.64 - 3.42 (4H, m), 3.31 - 3.21 (4H, m), 2.14 - 2.03 (2H, m), 1.44 (9H, s).

15 **c) Acetic acid, [4-chloro-2-[(hexahydro-4-(phenylsulfonyl)-1H-1,4-diazepin-1-yl)methyl]phenoxy]-, 1,1-dimethylethyl ester**

Benzene sulphonyl chloride (0.49 ml) was added dropwise over 2 min to a vigorously stirred solution of the product of step (b) (0.56 g) and NaHCO<sub>3</sub> (0.34 g) in DCM (3 ml) and water (3 ml). The reaction mixture was vigorously stirred for 2.5 days then diluted with DCM, washed with water (x1) then brine (x1), dried (MgSO<sub>4</sub>), filtered and concentrated *in*  
20 *vacuo*. The residue was purified using SCX resin (washed with MeOH and eluted with methanolic ammonia) to give a pale yellow oil (0.23 g).

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 7.80 (2H, dd), 7.59 - 7.50 (3H, m), 7.36 (1H, s), 7.13 (1H, dd), 6.63 (1H, d), 4.48 (2H, s), 3.69 (2H, s), 3.41 (4H, t), 2.79 - 2.68 (4H, m), 1.90 - 1.79 (2H, m), 1.47 (9H, s).

25

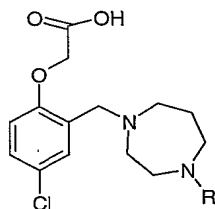
**d) Acetic acid, [4-chloro-2-[(hexahydro-4-(phenylsulfonyl)-1H-1,4-diazepin-1-yl)methyl]phenoxy]-**

Trifluoroacetic acid (15 ml) was added to the product of step (c) and the reaction mixture stirred for 14 h. Toluene (15 ml) was added and the mixture concentrated *in vacuo*.

30 The residue was purified using RPHPLC to give the title compound (158 mg) as a white solid. MS: APCI (+ve): 439 (M+).

$^1\text{H}$  NMR (300 MHz,  $\text{DMSO-}d_6$ )  $\delta$  7.80 (2H, dd), 7.74 – 7.59 (3H, m), 7.36 (1H, s), 7.38 (1H, d), 7.33 (1H, dd), 7.09 (1H, d), 4.51 (2H, s), 4.48 (2H, s), 3.47 – 3.41 (2H, m), 3.30 (2H, t), 2.99 – 2.90 (4H, m), 1.98 – 1.88 (2H, m).

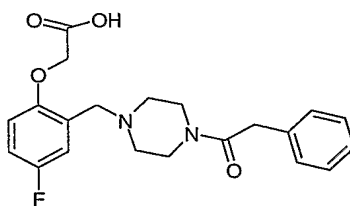
Examples 75 to 77 were synthesised from the product of example 75 part (b) using the method of example 75 parts (c) and (d)



Example number	EXAMPLE	R	M/Z
76	Acetic acid, [4-chloro-2-[[hexahydro-4-[(phenylmethyl)sulfonyl]-1H-1,4-diazepin-1-yl]methyl]phenoxy]-		453 [M+]
77	Acetic acid, [4-chloro-2-[[hexahydro-4-(phenylacetyl)-1H-1,4-diazepin-1-yl]methyl]phenoxy]-		417 [M+]

#### 10 Example 78

##### [4-Fluoro-2-[4-(phenyl)acetyl-1-piperazinyl]methyl]phenoxy]-acetic acid



##### a) 2-Chloromethyl-4-fluoro-1-methoxy-benzene

A solution of 4-fluoromethoxybenzene (5.04g), formalin (3.6ml) in concentrated hydrochloric acid (28ml) and 4M hydrochloric acid in dioxan (16ml) was stirred at 50°C for 18 h. The mixture was extracted with ether (x 3) and the organics washed with aqueous

sodium bicarbonate then brine, dried ( $\text{Na}_2\text{SO}_4$ ) and evaporated *in vacuo* to a colourless oil which solidified (6.0g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.10 (1H, dd), 6.99 (1H, m), 6.81 (1H, dd), 4.61 (2H, s), 3.86 (3H, s).

5 **b) 4-[(5-fluoro-2-methoxyphenyl)methyl]-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

A mixture of product from part a), 1-BOC-piperazine (5.3 g) and anhydrous potassium carbonate (7.1 g) was stirred in ethanol (20 ml) at room temperature for 18 h. Water was added to the reaction and extracted with dichloromethane (x 3), dried ( $\text{Na}_2\text{SO}_4$ ) and

10 evaporated to give title compound as a viscous oil (8.6 g).

MS: APCI (+ve): 268 (M+H-56).

**c) 1-[(5-fluoro-2-methoxyphenyl)methyl]-piperazine**

The product from part b) was dissolved (8.6 g) in a mixture of dichloromethane (10ml) and trifluoroacetic acid (20 ml) to be stirred at 40°C overnight. The solvents were removed  
15 under reduced pressure, using toluene as azeotrope. The resulting solid was dissolved in ethyl acetate and shaken with saturated aqueous sodium bicarbonate (100 ml) and extracted further with ethyl acetate. The combined organics were dried ( $\text{Na}_2\text{SO}_4$ ) and evaporated to give a solid (8.3 g).

MS: APCI (+ve): 225 (M+H).

20

**d) 1-[(5-fluoro-2-methoxyphenyl)methyl]-4-(phenylacetyl)-piperazine**

The product from part c) (1.6 g) was dissolved in dichloromethane (60 ml) and cooled to 0°C, phenylacetyl chloride (1.1 g) and triethylamine (1.2 ml) were added dropwise. The reaction mixture was stirred at room temperature for 4 h then poured into water, extracted  
25 with dichloromethane (x 3), dried ( $\text{Na}_2\text{SO}_4$ ), and evaporated to give an orange gum (2.2 g).

MS: APCI (+ve): 343 (M+H).

**e) 1-[(5-fluoro-2-hydroxyphenyl)methyl]-4-(phenylacetyl)-piperazine**

The product from part d) (1.0 g) was dissolved in dry dichloromethane (30 ml), cooled to 0°C  
30 and 1.0M boron tribromide in dichloromethane (16 ml) then added. The reaction mixture was quenched after 50 minutes with ice-water and the organic layer was separated. The aqueous layer was basified with aqueous potassium carbonate and then extracted with ethyl

acetate (x 3), the combined organics were washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>) to give the sub-title compound as a white solid (0.61 g).

MS: APCI (+ve): 365 (M+H).

5 **f) [4-fluoro-2-[[4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

The product from part e) (0.33 g) was suspended in acetonitrile (20 ml) and to it was added anhydrous potassium carbonate (0.15 g) and *t*-butyl bromoacetate (0.22 g), the reaction was heated to reflux for 24 hours. Then cooled to room temperature, the mixture was  
10 concentrated *in vacuo* and water added. The pH was adjusted to 6 by addition of aqueous ammonium chloride and extracted with ethyl acetate (x 3), washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>), and concentrated *in vacuo* to give the sub-title compound (0.29 g).  
MS: APCI (+ve): 443 (M+H).

15 **g) [4-Fluoro-2-[4-(phenyl)acetyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

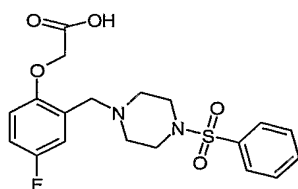
The product from part f) (0.22 g) was dissolved in trifluoroacetic acid (2 ml) and stirred under nitrogen for 24 hours. The solvents were removed under reduced pressure using toluene as azeotrope and the residue purified by reverse phase HPLC to give the title compound as a white solid (44 mg).

20 MS: APCI (-ve): 385 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.22 to 7.37 (5H, m), 7.08 (1H, dd), 6.99 (1H, m), 6.83 (1H, dd), 4.73 (2H, s), 3.90 (2H, bs), 3.71 (2H, s), 3.68 (2H, t), 3.65 (2H, s), 2.75 (2H, bs), 2.44 (2H, bs).

25 **Example 79**

**[4-Fluoro-2-[[4-[(phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**



**a) 2-[[4-(Phenyl)sulphonyl]-1-piperazinyl]-4-fluoro-1-methoxybenzene**

The product from Example 43 part c) (1.6 g) was dissolved in dichloromethane (60 ml) at room temperature before addition of benzenesulfonyl chloride (1.3 g) and triethylamine (1.2 ml) was made. Stirred at room temperature for 4 hours and poured into water, extracted with dichloromethane (x 3), dried (Na<sub>2</sub>SO<sub>4</sub>), and concentrated *in vacuo* to give the sub-title compound (2.1 g).

MS: APCI (+ve): 365 (M+H).

**b) 2-[[4-(Phenyl)sulphonyl]-1-piperazinyl]-4-fluorophenol**

The product from part a) (2.1 g) was dissolved in dry dichloromethane (50 ml), cooled to 0°C. A solution of 1.0M boron tribromide in dichloromethane (12 ml) was added. After 50 minutes the reaction was quenched with ice-water and the organics separated. The aqueous layer was basified with aqueous potassium carbonate and extracted with ethyl acetate (x 3) and the combined organics were washed with brine, then dried (Na<sub>2</sub>SO<sub>4</sub>) to give the sub-title compound (1.4 g).

MS: APCI (+ve): 351 (M+H).

**c) [4-Fluoro-2-[4-(phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid t-butyl ester**

Anhydrous potassium carbonate (0.23 g) and t-butyl bromoacetate (0.33 g) were added to a suspension of the product from part b) (0.53 g) in acetonitrile (30 ml). The reaction heated to reflux for 24 hours, cooled to room temperature and concentrated *in vacuo*. Water was added and the pH was adjusted to 6 by addition of aqueous ammonium chloride and extracted with ethyl acetate (x 3), shaken with brine, dried (Na<sub>2</sub>SO<sub>4</sub>), and concentrated *in vacuo* to give a gum (0.37 g).

MS: APCI (+ve): 465 (M+H).

**d) [4-Fluoro-2-[[4-(phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

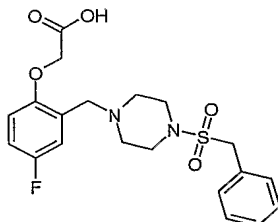
The product from part c) (0.27 g) was dissolved in trifluoroacetic acid (2 ml) and stirred under nitrogen for 48 hours. The solvents were removed under reduced pressure using toluene as azeotrope and the residue purified reverse phase HPLC using to give the title compound (0.14 g).

MS: APCI (-ve): 407 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.73 (2H, d), 7.62 (1H, t), 7.54 (2H, t), 7.06 (1H, m), 6.95 (1H, m), 6.90 (1H, dd), 4.67 (2H, s), 3.73 (2H, s), 3.34 (4H, bs), 2.85 (4H, bs).

### **Example 80**

#### **5 [4-Fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**



#### **a) 1-[(5-fluoro-2-methoxyphenyl)methyl]-4-[(phenylmethyl)sulfonyl]-piperazine**

Phenylmethanesulfonyl chloride (0.7 g) and triethylamine (0.6 ml) were added dropwise to a solution of the product from Example 43 part c) (0.8 g) in dichloromethane (30 ml) at room temperature. The reaction mixture was stirred at room temperature for 4 hours then poured into water, extracted with dichloromethane (x 3), dried ( $\text{Na}_2\text{SO}_4$ ), and concentrated *in vacuo* to give a solid (0.98 g).

MS: APCI (+ve): 379 (M+H).

#### **15 b) 1-[(5-fluoro-2-hydroxyphenyl)methyl]-4-[(phenylmethyl)sulfonyl]-piperazine**

The sub-title compound was prepared by the method of example 78 part e) from the product from part a).

MS: APCI (+ve): 365 (M+H).

#### **20 c) [4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

The sub-title compound was prepared by the method of example 78 part f) from the product from part b).

MS: APCI (+ve): 479 (M+H).

25

#### **d) [4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

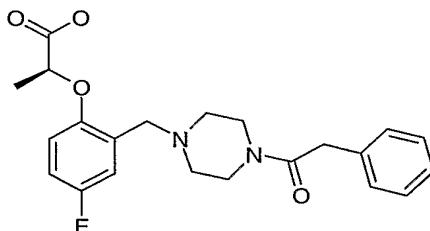
The title compound was prepared by the method of example 78 part g) from the product from part c).

MS: APCI (-ve): 407 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.35 to 7.44 (5H, m), 7.28 (1H, m), 7.23 (1H, m), 7.10 (1H, dd), 4.78 (2H, s), 4.52 (2H, s), 4.19 (2H, s), 3.32 (4H, bs), 3.09 (4H, bs).

### **Example 81**

#### **5 (2S)-2-[4-fluoro-2-[[4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid**



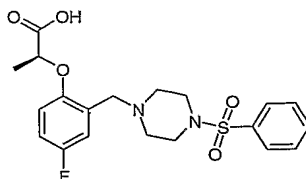
#### **a) (2S)-2-[4-fluoro-2-[[4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid, 1,1-dimethylethyl ester**

- 10 The product from Example 78 part e) (0.44 g) was suspended in anhydrous THF (5ml) (+)-*tert*-butyl *D*-lactate (0.22 g) and triphenylphosphine (0.42 g) were added and the reaction was then cooled to 0°C. Diisopropyl azodicarboxylate (0.35 ml) was added dropwise and the resulting mixture was allowed to stir at room temperature overnight, then concentrated *in vacuo*. The residue was purified by silica flash chromatography using 10:1
- 15 dichloromethane/methanol as eluent to give the sub-title compound as a gum (0.31g).  
MS: APCI (+ve): 401 (M+1-56)

#### **b) (2S)-2-[4-fluoro-2-[[4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid**

- The title compound was prepared by the method of example 78 part g) using the product
- 20 form part a).  
MS: APCI (+ve): 401 (M+1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  9.40 (1H, bs), 7.33 (2H, t), 7.27 (1H, t), 7.22 (2H, d), 7.03 (2H, m), 6.86 (1H, m), 4.95 (1H, q), 4.29 (1H, d), 3.97 (1H, bs), 3.89 (1H, bs), 3.79 (2H, bs), 3.69 (2H, t), 3.17 (1H, d), 2.83 (2H, bs), 2.62 (2H, bs), 1.62 (3H, d)

**Example 82****(2S)-2-[4-fluoro-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid**

5 **a) (2S)-2-[4-fluoro-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid, 1,1-dimethylethyl ester**

The sub-title compound was prepared by the method of example 81 part a) using the product from example 79 part b)

MS: APCI (+ve): 479 (M+1)

10 **b) (2S)-2-[4-fluoro-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid**

The title compound was prepared by the method of example 78 part g) using the product from part a).

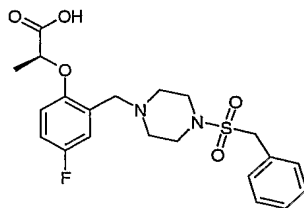
MS: APCI (-ve): 421 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.72 (2H, d), 7.63 (1H, t), 7.54 (2H, t), 7.02 (1H, m), 6.93 (1H, m),

15 6.88 (1H, m), 4.88 (1H, m), 4.23 (1H, d), 3.04 (1H, d), 2.82 (4H, bs), 2.82 (4H, bs), 1.62 (3H, d).

**Example 83**

20 **(2S)-2-[4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid**



**a) (2S)-2-[4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid, 1,1-dimethylethyl ester**

The sub-title compound was prepared by the method of example 81 part a) using the product from example 80 part b).

MS: APCI (+ve): 492 (M+1)

**b) (2S)-2-[4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1piperazinyl]methyl]phenoxy]-propanoic acid**

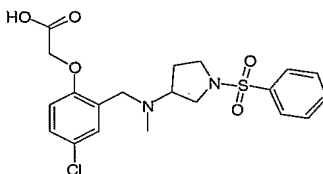
The title compound was prepared by the method of example 78 part g) using the product from part a).

5 MS: APCI (-ve): 437 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.41 (5H, m), 7.06 (1H, m), 6.99 (1H, m), 6.86 (1H, dd), 4.893 (1H, q), 4.23 (4H, m), 3.31 (4H, bs), 2.71 (4H, bs), 1.65 (3H, d).

**Example 84**

10 **[4-chloro-2-[[methyl[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid, trifluoroacetate**



**(a) [1-(phenylsulfonyl)-3-pyrrolidinyl]-carbamic acid, 1,1-dimethylethyl ester**

15 To a solution of 3-(*tert*-butoxycarbonylamino)pyrrolidine (0.7 g) in THF (20 ml) cooled to 0°C was added triethylamine (0.52 ml) followed by the addition of benzenesulfonyl chloride (0.48 ml) dropwise over 5 minutes. After stirring for 2 hours the mixture was poured into water and the organics extracted into ether. The ether extractions were combined, washed with brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to give crude material.

20 Trituration with ether gave subtitle compound as a colourless solid (0.9 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.85 - 7.82 (2H, m), 7.65 - 7.60 (1H, m), 7.58 - 7.53 (2H, m), 4.48 (1H, s), 4.09 (1H, s), 3.45 - 3.33 (2H, m), 3.21 (2H, s), 2.04 (1H, m), 1.75 (1H, s), 1.41 (9H, s).

**(b) methyl[1-(phenylsulfonyl)-3-pyrrolidinyl]- carbamic acid, 1,1-dimethylethyl ester**

25 To a suspension of sodium hydride (60% dispersion in mineral oil) (49 mg) in tetrahydrofuran (10ml) was added the product from part (a) (400 mg) as a solution in tetrahydrofuran (5ml). After 30 minutes methyl iodide (90ul) was added and the reaction stirred overnight. The mixture was poured into water and the organics extracted into ether. The ether extractions were combined, washed with brine, dried (MgSO<sub>4</sub>) and concentrated *in*

*vacuo* to give crude product. Purification by column chromatography (eluent 20%EtOAc/Hexane) gave the subtitle compound as an oil (235mg).

MS: APCI (+ve): 341 (M+H<sup>+</sup>)

5 **(c) N-methyl-1-(phenylsulfonyl)-3-pyrrolidinamine, trifluoroacetate**

To a solution of the product from part (b) (231 mg) in dichloromethane (5 ml) was added trifluoroacetic acid (5 ml). After stirring at room temperature for 2 hours the reaction was concentrated *in vacuo* and the residue triturated with ether to give subtitle compound as a solid (220 mg).

10 <sup>1</sup>H NMR (d6-DMSO) δ 8.79 (2H, s), 7.84 - 7.64 (5H, m), 3.67 (1H, m), 3.40 - 3.31 (2H, m), 3.24 (1H, m), 3.09 (1H, m), 2.54 (3H, s), 2.10 (1H, m), 1.88 (1H, m)

MS: APCI (+ve): 241 (M+H<sup>+</sup>)

**(d) [4-chloro-2-(hydroxymethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester**

15 To a solution of (4-chloro-2-formylphenoxy)-acetic acid, 1,1-dimethylethyl ester (2.1g) in ethanol (20ml) was added sodium borohydride (0.29g). After stirring for 10 minutes the reaction was concentrated *in vacuo* and water added to the residue. The organics were extracted into ethylacetate, washed with brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to give the subtitle compound as an oil (2g).

20 <sup>1</sup>H NMR (CDCl<sub>3</sub>) 7.29 (1H, d), 7.20 (1H, dd), 6.72 (1H, d), 4.68 (2H, s), 4.57 (2H, s), 2.04 (1H, s), 1.48 (9H, s)

**(e) [4-chloro-2-[(methylsulfonyl)oxy]methyl]phenoxy]- acetic acid, 1,1-dimethylethyl ester**

25 A solution of the product of part (d) (1g) and triethylamine (0.51ml) in dichloromethane (10ml) was cooled to 0°C. Methanesulfonyl chloride (0.29ml) was then added dropwise and the reaction was allowed to reach room temperature. After stirring for 3 hours the reaction was diluted with dichloromethane, washed with water, NaHCO<sub>3</sub> (aq), brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to give the subtitle compound as an oil (1.13g).

30 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.40 (1H, s), 7.29 (1H, d), 6.71 (1H, d), 5.31 (2H, s), 4.56 (2H, s), 3.05 (3H, s), 1.47 (9H, s)

**(f) [4-chloro-2-[[methyl[1-(phenylsulfonyl)-3-pyrrolidinyl]amino] methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

A solution of the product from part (c) (217mg), part (e) (213mg) and triethylamine (0.17ml) in DMF (5ml) was stirred overnight at room temperature. The reaction was diluted with water, pH adjusted to 9 using NaHCO<sub>3</sub> (aq) and the organics extracted into ether. The ether extractions were combined, washed with brine, dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to give a crude material. Purification using column chromatography (eluent 33% EtOAc/Hexane) gave the subtitle compound as an oil (93mg).

Used without characterisation in step (g)

**(g) [4-chloro-2-[[methyl[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid, trifluoroacetate**

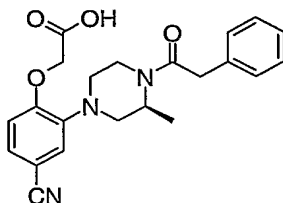
To a solution of the product from part (f) (93mg) in dichloromethane (3ml) was added trifluoroacetic acid (3ml). After 2 hours the reaction was concentrated *in vacuo* and the residue triturated with ether to give title compound as a white solid (70mg).

<sup>1</sup>H NMR (d<sub>6</sub>-DMSO at 90°C) δ 7.82 (2H, d), 7.73 - 7.60 (3H, m), 7.41 (1H, d), 7.35 (1H, dd), 7.05 (1H, d), 4.69 (2H, s), 3.93 (2H, s), 3.59 - 3.09 (5H, m), 2.40 (3H, s), 2.16 (1H, m), 1.99 (1H, m)

MS: APCI (-ve): 437 (M-H)

**Example 85**

**[4-Cyano-2-[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid**



**a) (4-Cyano-2-formylphenoxy)acetic acid, 1,1-dimethylethyl ester**

Prepared by the method of example 1 part (d) using 3-formyl-4-hydroxy-benzonitrile to give the title compound (1.4 g).

MS: APCI (+ve): 262 (M+1)

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 10.51 (1H, s), 8.16 (1H, d), 7.80 (1H, dd), 6.94 (1H, d), 4.73 (2H, s), 1.49 (9H, s)

**b) [4-Cyano-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid**

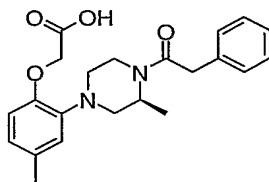
Prepared by the method of example 55 part (b), using the product from part (a) (250 mg) and the product from example 64 part (b) (330 mg) to give the title compound (90 mg).

5 MS: APCI (-ve): 406 (M-1)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.73 (1H, d), 7.69 (1H, dd), 7.30 (2H, m), 7.21 (3H, m), 7.04 (1H, d), 4.73 (2H, s), 4.61 - 4.51 (1H, m), 4.26 - 4.12 (1H, m), 3.68 (2H, s), 3.52 (2H, s), 3.29 - 3.16 (1H, m), 2.93 - 2.72 (1H, m), 2.72 - 2.62 (1H, m), 2.09 (1H, m), 1.93 (1H, m), 1.18 (3H, d)

10 **Example 86**

**[4-Methyl-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid**



**a) (2-Formyl-4-methylphenoxy)acetic acid**

Prepared by the method of example 1 part (d) using 2-hydroxy-5-methyl- benzaldehyde  
15 to give the title compound.

MS: APCI (+ve): 251 (M+1)

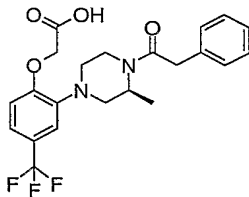
$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  10.54 (1H, s), 7.66 (1H, d), 7.33 (1H, dd), 6.75 (1H, d), 4.61 (2H, s), 2.32 (3H, s), 1.48 (9H, s)

20 **b) [4-Methyl-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid**

Prepared by the method of example 55 part (b), using the product from part (a) (240 mg) and the product from example 64 part (b) (330 mg) to give the title compound (100 mg).

MS: APCI (-ve): 397 (M-1)

25  $^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.31 (2H, m), 7.22 (3H, m), 7.14 (1H, d), 7.02 (1H, dd), 6.82 (1H, d), 4.56 (2H, dd), 4.30 - 4.16 (1H, m), 3.85 - 3.48 (2H, m), 3.69 (2H, s), 3.57 (2H, s), 2.90 - 2.72 (2H, m), 2.28 - 2.16 (1H, m), 2.12 - 1.98 (1H, m), 1.17 (3H, d).

**Example 87****[2-[[[(3S)-3-Methyl-4-(phenylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]acetic acid**

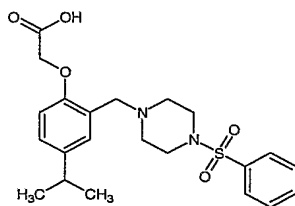
5 Prepared by the method of example 55 part (b), using the product from example 1 part (d) (300 mg) and the product from example 64 part (b) (330 mg) to give the title compound (130 mg).

MS: APCI (-ve): 451 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.71 (1H, s), 7.56 (1H, d), 7.30 (2H, m), 7.21 (3H, m), 7.05 (1H, d),  
 10 4.72 (2H, s), 4.56 (1H, m), 4.22 (1H, m), 3.81 - 3.52 (1H, m), 3.68 (2H, s), 3.56 (2H, s), 3.23 (1H, m), 2.93 - 2.59 (2H, m), 2.02 (2H, m), 1.17 (3H, d).

**Example 88****Sodium [4-(1-methylethyl)-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-**

15 **acetate**

**a) 1,1-Dimethylethyl 4-[[2-methoxy-5-(1-methylethyl)phenyl]methyl]-1-piperazinecarboxylate**

A mixture of 2-(chloromethyl)-1-methoxy-4-(1-methylethyl)benzene (2.55 g), 1,1-dimethylethyl 1-piperazinecarboxylate (2.41 g) and potassium carbonate (3.17 g) in ethanol  
 20 (20 ml) was stirred for 20 h. Water was added and the mixture was extracted with dichloromethane. The organic extracts were dried (MgSO<sub>4</sub>), evaporated *in vacuo* and purified by chromatography (silica, petrol – ether as eluent) to give the sub-title compound (2.17 g).

MS: APCI (+ve): 349 (M+H<sup>+</sup>)

**b) 1-[[2-Methoxy-5-(1-methylethyl)phenyl]methyl]- piperazine**

A solution of the product from step (a) (1.98 g) in TFA (4 ml) and dichloromethane (2 ml) was stirred for 2 h. The solvent was removed *in vacuo* and the residue azeotroped with toluene. Aq. potassium carbonate was added and the mixture was extracted with  
5 dichloromethane. The organic extracts were dried (MgSO<sub>4</sub>) and evaporated *in vacuo* to give the sub-title compound (1.79 g).

MS: APCI (+ve): 249 (M+H<sup>+</sup>)

**c) 1-[[2-Methoxy-5-(1-methylethyl)phenyl]methyl]-4-(phenylsulfonyl)- piperazine**

10 Phenylsulfonyl chloride (0.24 ml) was added to a solution of the product from step (b) (396 ml) and triethylamine (0.44 ml) in dichloromethane (3 ml) and the mixture was stirred for 3 h. Water was added and the mixture was extracted with dichloromethane. The organic extracts were dried (MgSO<sub>4</sub>), evaporated *in vacuo* and purified by chromatography (silica, petrol – ether as eluent) to give the sub-title compound (431 mg).

15 MS: APCI (+ve): 389 (M+H<sup>+</sup>)

**d) 1-[[2-Hydroxy-5-(1-methylethyl)phenyl]methyl]-4-(phenylsulfonyl)- piperazine**

Boron tribromide (2.3 ml, 1 M in DCM) was added to a solution of the product from step c) (431 mg) in DCM at 0 °C. Aq sodium bicarbonate was added after 20 min and the mixture was extracted with dichloromethane. The organic extracts were dried (MgSO<sub>4</sub>) and,  
20 evaporated *in vacuo* to give the sub-title compound (553 mg).

MS: APCI (+ve): 375 (M+H<sup>+</sup>)

**e) Ethyl [4-(1-methylethyl)-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-acetate**

A mixture of the product from step (d) (244 mg), ethyl bromoacetate (0.1 ml) and  
25 potassium carbonate (185 mg) in acetone was heated under reflux for 2 days. Water was added and the mixture was extracted with diethyl ether. The organic extracts were dried (MgSO<sub>4</sub>), evaporated *in vacuo* and purified by chromatography (silica, petrol – ether as eluent) to give the sub-title compound (113 mg).

MS: APCI (+ve): 461 (M+H<sup>+</sup>)

**f) Sodium [4-(1-methylethyl)-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-acetate**

A solution of the product from step (e) (113 mg) in NaOH (0.25 ml, 1M), THF (1.5 ml) and MeOH (1 ml) was stirred for 4 h. The solvent was removed *in vacuo* and the residue

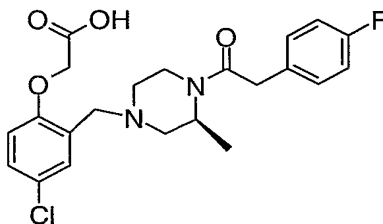
5 trituated with ether to give the title compound (97 mg)

MS: APCI (-ve): 431 (M-1)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.61-7.64 (5H, m), 6.99 (1H, s), 6.97 (1H, d), 6.67 (1H, d), 4.09 (2H, s), 3.49 (2H, s), 2.91 (4H, s), 2.76 (1H, heptet), 2.52 (4H, s), 1.12 (6H, d).

**Example 89**

10 **[4-chloro-2-[[[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl] phenoxy]-acetic acid**



**a) (3S)-3-methyl-1-(triphenylmethyl)-piperazine**

15 (S)-+2-methylpiperazine (10 g) was dissolved in acetonitrile (140 ml) and cooled to 5-10°C whereupon triethylamine (35 ml) was added, followed by drop wise addition of a solution of trityl chloride 27.9 (g) in DCM (80 ml). The reaction was stirred for 1 h at room temperature. The resulting slurry was cooled to approximately 0°C then filtered. The filtrate was evaporated *in vacuo* and the residue was purified by chromatography (silica, 1-4% MeOH/ DCM as eluent) to give the sub-title compound (29 g).

20

**b) (2S)-1-piperazinecarboxylic acid, 2-methyl-4-(triphenylmethyl)-1,1-dimethylethyl ester**

Triethylamine (24 ml) was added to a solution of the product from part a) (29 g) in 25 methanol (350 ml). BOC-anhydride (18.9 g) was then added to the reaction mixture and stirred overnight. The solvents were evaporated *in vacuo* and the residue partitioned between ethyl acetate and saturated brine. The organic layer was separated and washed with brine, dried (Na<sub>2</sub>SO<sub>4</sub>) the concentrated *in vacuo* to give the sub-title compound (41 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.49-7.16 (15H, m), 4.13 (1H, t), 3.74 (1H, d), 3.33 (1H, t), 2.97 (4H, m), 1.68 (3H, dd) and 1.33 (9H, s).

**c) (2S)-2-methyl-1-piperazinecarboxylic acid-1,1-dimethylethyl ester**

2M HCl (50 ml) was added drop wise to a solution of the product of part (b) (31.8 g) in ethanol (1500 ml), the reaction was stirred for 1.5 h. Solid sodium hydrogen carbonate (8.4 g) was added and stirred for 1 h, then concentrated *in vacuo*. The residue was purified by chromatography (silica, 0-2-5% MeOH/ DCM as eluent) to remove the by-products, then eluted with 10% MeOH/DCM to give the sub-title compound (9.3 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  4.51 (1H, t), 4.05 (1H, d), 3.41 (2H, m), 3.20 (1H, d), 3.09 (1H, dd), 2.87 (1H, t) and 1.44 (12H, m).

**d) (2S)-4-[[5-chloro-2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]phenyl]methyl]-2-methyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

The product of example 13 part (a) (9.1 g), the product of part c)  $\text{MgSO}_4$  (18 g) and anhydrous THF (350 ml) were charged to a flask and stirred overnight. Sodium triacetoxo borohydride (11.7 g) was added portion wise and the mixture stirred overnight then concentrated *in vacuo*. The residue was partitioned between ethyl acetate and water; the organic phase was washed with ethyl acetate. The combined organic extracts were dried ( $\text{Na}_2\text{SO}_4$ ) and concentrated *in vacuo*. The residue was purified by chromatography (silica, 80% isohexane/ethyl acetate as eluent) to give the sub-title compound (9.2 g).

MS: ESI (+ve): 455 (M+1)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.44 (1H, d), 7.12 (1H, dd), 6.64 (1H, d), 4.49 (2H, s), 4.2 (1H, s), 3.8 (1H, d), 3.55 (2H, s), 3.1 (1H, t), 2.65 (1H, d), 2.25 (1H, d), 2.21 (1H, d), 2.09 (1H, t) and 1.28 (3H, d).

**e) (2S)-4-[[5-chloro-2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]phenyl]methyl]-2-methyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester TFA salt.**

TFA (13 ml) was added to a solution of the product of step (d) (3.8 g) in DCM (40 ml) and stirred for 50 min. Toluene was added and the mixture was concentrated *in vacuo* to give the sub-title compound.

MS: ESI (+ve): 355 (M+H)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.41 (2H, m), 7.25-6.98 (4H, m), 6.78 (1H, d), 4.66 (2H, d), 4.05 (1H, broad s), 3.77 (3H, broad s), 3.66 (3H, broad s), 2.36 (1H, t), 2.65 (1H, d), 2.25 (1H, d), 2.21 (1H, d), 2.09 (1H, t) and 1.28 (1H, d).

5 **f) [4-chloro-2-[[[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid, 1,1-dimethylethyl ester**

The product of part (e) (0.39 g) was dissolved in DCM (10 ml) and a solution of sodiumhydrogen carbonate (0.42 g) in water (10 ml) was added. 4-fluorophenylacetyl chloride (0.18 g) was added drop wise and stirred overnight at room temperature. The  
10 reaction mixture was washed with DCM (x3). The combined organic extracts were dried ( $\text{Na}_2\text{SO}_4$ ) and evaporated to give the sub-title compound (0.18 g).

**g) [4-chloro-2-[[[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

15 The product from part (f) (180 mg) and TFA (2 ml) were charged to a flask and stirred for 5 h. Toluene was added and the reaction mixture concentrated *in vacuo*. The residue was purified by reverse phase HPLC to give the title compound (60 mg).

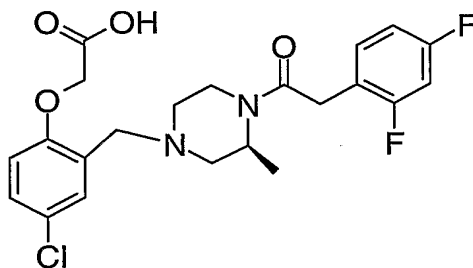
MS: APCI (+ve): 435 (M+H)

$^1\text{H}$  NMR ( $\text{CDCl}_3$  at  $50^\circ\text{C}$ )  $\delta$  7.28 (2H, m), 7.17 (2H, m), 7.00 (2H, m), 6.9 (1H, d), 4.59 (2H, d), 4.5 (1H, broad s), 3.91 (1H, broad s), 3.69 (1H, d), 3.66 (2H, s), 3.44 (1H, broad s), 3.40 (1H, broad s), 2.38 (1H, d), 2.09 (1H, t) and 1.33 (3H, d).  
20

**Example 90**

**[4-chloro-2-[[[(3S)-4-[(2,4-difluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

25



**a) 2,4-difluoro-benzeneacetyl chloride**

2,4-difluoroacetic acid (0.3 g) and DCM (10 ml) were charged to a flask. Oxalyl chloride (0.2 ml) was added followed by DMF (catalytic amount), and stirred for 1 h.

Toluene was added and the reaction mixture was concentrated *in vacuo* to give the sub-title compound – used directly without characterisation.

**b) [4-chloro-2-[[[(3S)-4-[(2,4-difluorophenyl)acetyl]-3-methyl-1-**

**5 piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

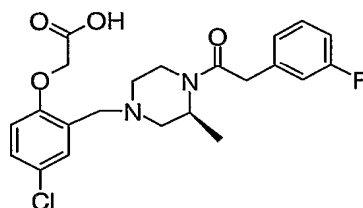
MS: APCI (+ve): 453 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 7.33-7.21 (3H, m), 7.16 (1H, d), 6.95 (1H, d), 6.83 (2H, m), 4.6  
10 (1H, broad s), 3.71 (1H, d), 3.64 (2H, s), 3.52 (1H, d), 3.45 (1H, broad s), 3.01 (1H, d), 2.88  
(1H, d), 2.44 (1H, d), 2.19 (1H, t) and 1.34 (3H, d).

**Example 91**

**[4-chloro-2-[[[(3S)-4-[(3-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-**

**15 acetic acid**



**a) 3-fluoro-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 3-  
20 fluorophenyl acetic acid.

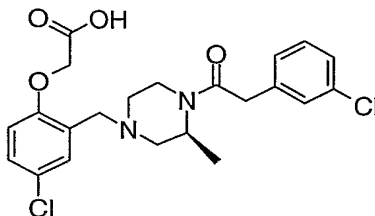
**b) [4-chloro-2-[[[(3S)-4-[(3-fluorophenyl)acetyl]-3-methyl-1-**

**piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example  
25 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 435 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 7.33-7.27 (2H, m), 7.16 (1H, d), 7.00-6.86 (4H, m), 3.73 (1H, d),  
3.7 (2H, s), 3.55 (1H, d), 3.46 (1H, broad s), 3.01 (1H, d), 2.92 (1H, d), 2.41 (1H, d), 2.15  
(1H, t) and 1.34 (3H, d).

**Example 92****[4-chloro-2-[[[(3S)-4-[(3-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid]****a) 3-chloro-benzeneacetyl chloride**

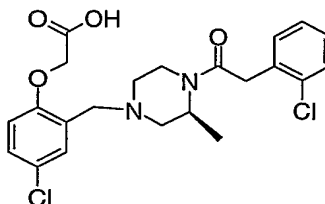
The sub-title compound was prepared by the method of example 90 part (a) using 3-chlorophenyl acetic acid.

**b) [4-chloro-2-[[[(3S)-4-[(3-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid]**

The title compound was prepared by the method of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 451 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 7.39-7.15 (6H, m), 6.92 (1H, dd), 4.8 (1H, d), 4.61 (1H, d), 4.57 (1H, broad s), 4.01 (1H, broad s), 3.86 (2H, s), 3.72 (1H, d), 3.51 (1H, d), 3.44 (1H, broad, s), 3.01 (1H, d), 2.94 (1H, d), 2.47 (1H, d), 2.19 (1H, t) and 1.33 (3H, d).

**Example 93****[4-chloro-2-[[[(3S)-4-[(2-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid]****a) 2-chloro-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 2-chlorophenyl acetic acid.

**b) [4-chloro-2-[[[(3S)-4-[(2-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

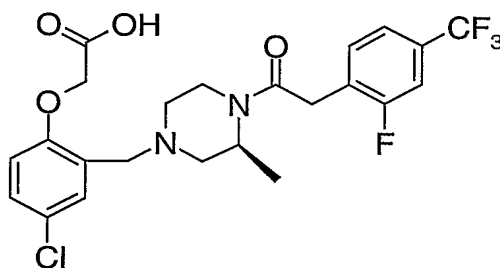
5 MS: APCI (+ve): 451 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 7.32-7.23 (4H, m), 7.14 (1H, d), 7.1 (1H, t), 6.9 (1H, d), 4.79 (1H, d), 4.59 (1H, d), 4.50 (1H, broad s), 3.97 (1H, broad s), 3.67 (2H, s), 3.67 (1H, d), 3.49 (1H, d), 3.4 (1H, broad s), 2.96 (1H, d), 2.88 (1H, d), 2.37 (1H, d), 2.1 (1H, t) and 1.31 (3H, d).

10

**Example 94**

**[4-chloro-2-[[[(3S)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**



15 **a) 2-fluoro-4-(trifluoromethyl)-benzeneacetyl chloride**

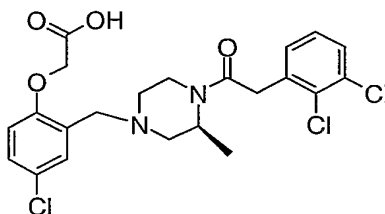
The sub-title compound was prepared by the methods of example 90 part (a) using 2-fluoro-4-trifluoromethylphenyl acetic acid.

20 **b) [4-chloro-2-[[[(3S)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the method of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 503 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 9.65 (1H, broad, s), 7.39 (2H, m), 7.3 (1H, d), 7.24 (2H, m), 6.84 (1H, d), 4.6 (2H, q), 4.51 (1H, broad, s), 3.99 (1H, d), 3.72 (2H, s), 3.65 (2H, q), 3.38 (1H, t), 2.99 (1H, d), 2.46 (1H, d), 2.26 (1H, t), and 1.33 (3H, d).

**Example 95****[4-chloro-2-[[[(3S)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

5

**a) 3,4-dichloro-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 3,4-dichlorophenyl acetic acid.

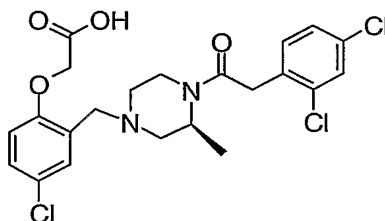
10

**b) [4-chloro-2-[[[(3S)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

15 MS: APCI (+ve): 485 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 9.45 (1H, m), 7.32 (1H, d), 7.24 (2H, m), 7.06 (1H, dd), 6.86 (1H, d), 4.6 (2H, q), 4.51 (1H, broad, s), 3.97 (1H, broad, s), 3.67 (2H, q), 3.64 (2H, s), 3.39 (1H, broad s), 3.03 (1H, d), 2.51 (1H, d), 2.27 (1H, t), and 1.32 (3H, d).

**20 Example 96****[4-chloro-2-[[[(3S)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid****a) 2,4-dichloro-benzeneacetyl chloride**

25 The sub-title compound was prepared by the method of example 90 part (a) using 2,4-dichlorophenyl acetic acid.

**b) [4-chloro-2-[[[(3S)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

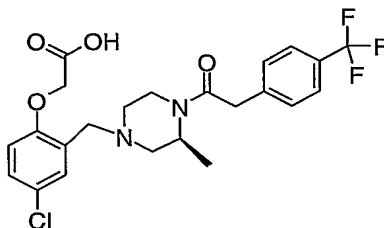
MS: APCI (+ve): 485 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 9.42 (1H, broad s), 7.38 (1H, s), 7.26 (4H, m), 6.88 (1H, d), 4.62 (2H, q), 4.59 (1H, broad s), 3.89 (1H, broad, s), 3.78 (2H, s), 3.73 (2H, q), 3.44 (1H, broad s), 3.05 (1H, d), 2.94 (1H, d), 2.53 (1H, d), 2.32 (1H, t) and 1.36 (3H, d).

10

**Example 97**

**[4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**



**a) 4-(trifluoromethyl)-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 4-trifluoromethylphenyl acetic acid.

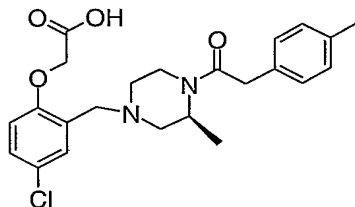
**b) [4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 485 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50°C) δ 9.35 (1H, broad s), 7.58 (2H, d), 7.26 (2H, m), 7.21 (1H, d), 6.88 (1H, d), 4.62 (2H, q), 4.43 (1H, broad, s), 3.95 (1H, broad s), 3.76 (2H, s), 3.62 (2H, q), 3.4 (1H, broad s), 3.00 (1H, d), 2.9 (1H, d), 2.46 (1H, d), 2.21 (1H, t) and 1.31 (3H, d).

20

**Example 98****[4-chloro-2-[[[(3S)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl] phenoxy]-acetic acid**

5

**a) 4-methyl-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 4-methylphenyl acetic acid.

10 **b) [4-chloro-2-[[[(3S)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl] phenoxy]-acetic acid**

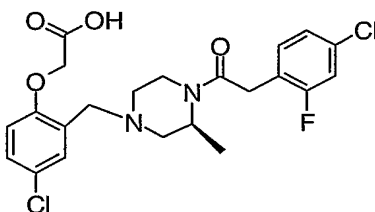
The title compound was prepared by the method of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 431 (M+H)

15  $^1\text{H}$  NMR ( $\text{CDCl}_3$  at  $50^\circ\text{C}$ )  $\delta$  8.6 (1H, broad s), 7.26 (1H, dd), 7.16 (1H, d), 7.1 (4H, m), 6.87 (1H, d), 3.66 (3H, broad s), 3.57 (2H, q), 3.35 (1H, broad s), 2.97 (1H, d), 2.89 (1H, d), 2.41 (1H, broad s), 2.32 (3H, s), 2.12 (1H, t), and 1.28 (3H, d).

**Example 99**

20 **[4-chloro-2-[[[(3S)-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

**-a) 4-chloro-2-fluoro-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 4-chloro-2-fluoro-phenyl acetic acid.

25

**b) [4-chloro-2-[[[(3S)-4-[(4-chloro-2-fluorophenyl)acetyl]]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

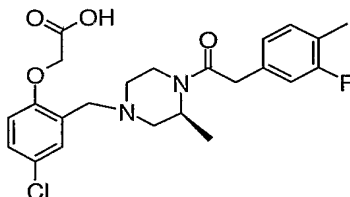
The title compound was prepared by the method of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

5 MS: APCI (+ve): 467 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50 °C) δ 8.96 (1H, broad s), 7.26 (3H, m), 7.09 (2H, m), 6.9 (1H, d), 4.63 (2H, q), 4.5 (1H, broad s), 3.97 (1H, broad s), 3.76 (2H, q), 3.64 (2H, s), 3.44 (1H, broad s), 3.06 (1H, d), 2.93 (1H, d), 2.53 (1H, d), 2.3 (1H, t) and 1.33 (3H, d).

10 **Example 100**

**[4-chloro-2-[[[(3S)-4-[(3-fluoro-4-methylphenyl)acetyl]]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**



**a) 3-fluoro-4-methyl-benzeneacetyl chloride**

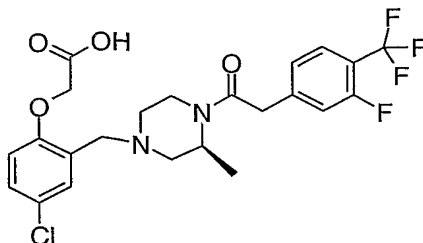
15 The sub-title compound was prepared by the method of example 90 part (a) using 3-fluoro-4-methylphenyl acetic acid.

**b) [4-chloro-2-[[[(3S)-4-[(3-fluoro-4-methylphenyl)acetyl]]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

20 The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 449 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50 °C) δ 8.52 (1H, broad s), 7.24 (2H, m), 7.1 (1H, t), 6.87 (3H, m), 4.6 (2H, q), 4.48 (1H, broad s), 3.97 (1H, broad s), 3.73 (2H, q), 3.64 (2H, s), 3.36 (1H, broad s),  
25 2.99 (1H, d), 2.89 (1H, d), 2.44 (1H, d), 2.24 (3H, s), 2.2 (1H, t) and 1.29 (3H, d).

**Example 101****[4-chloro-2-[[[(3S)-4-[[3-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid****5 a) 3-fluoro-4-(trifluoromethyl)-benzeneacetyl chloride**

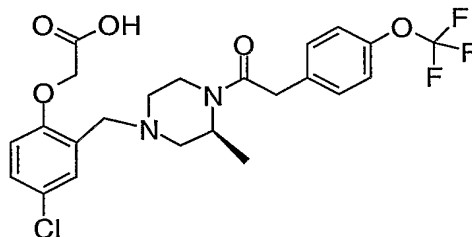
The sub-title compound was prepared by the method of example 90 part (a) using 3-fluoro-4-trifluoromethylphenyl acetic acid.

**10 b) [4-chloro-2-[[[(3S)-4-[[3-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

MS: APCI (+ve): 449 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50 °C) δ 7.65 (1H, broad s), 7.54 (1H, t), 7.28 (1H, m), 7.09 (2H, d), 4.6 (2H, q), 6.88 (1H, d), 4.69 (2H, q), 4.5 (1H, broad s), 3.97 (1H, broad s), 3.76 (2H, q), 3.72 (2H, s), 3.44 (1H, broad s), 3.04 (1H, d), 2.89 (1H, d), 2.4 (1H, d), 2.28 (1H, t) and 1.33 (3H, d).

**Example 102****20 [4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethoxy)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid****a) 4-(trifluoromethoxy)-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 3-  
25 trifluoromethoxyphenyl acetic acid.

**b) [4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethoxy)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid**

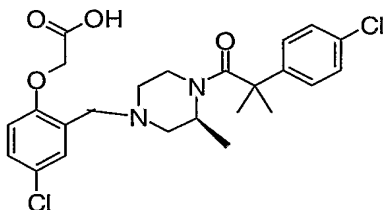
The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

5 MS: APCI (+ve): 499 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50 °C) δ 8.12 (1H, broad s), 7.24 (6H, m), 6.87 (1H, d), 4.61 (2H, q), 4.49 (1H, broad s), 3.96 (1H, broad s), 3.71 (2H, s), 3.61 (2H, q), 3.4 (1H, broad s), 3.00 (1H, d), 2.89 (1H, d), 2.44 (1H, d), 2.2 (1H, t) and 1.30 (3H, d).

10 **Example 103**

**[4-chloro-2-[[[(3S)-4-[2-(4-chlorophenyl)-2-methyl-1-oxopropyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**



**a) 4-chloro-α,α-dimethyl-benzeneacetyl chloride**

15 The sub-title compound was prepared by the method of example 90 part (a) using 4-chloro-α,α-dimethyl-benzeneacetic acid.

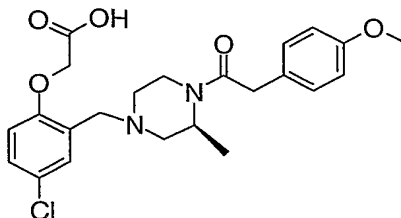
**b) [4-chloro-2-[[[(3S)-4-[2-(4-chlorophenyl)-2-methyl-1-oxopropyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

20 The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of part (a) and the product of example 89 part (e).

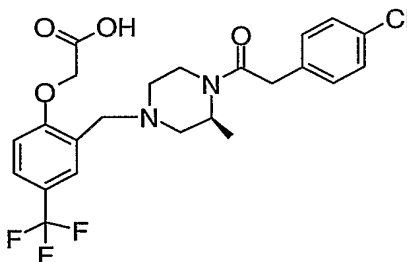
MS: APCI (-ve): 477 (M-H)

<sup>1</sup>H NMR (CDCl<sub>3</sub> at 50 °C) δ 8.39 (1H, broad s), 7.25 (1H, dd), 7.29 (1H, d), 7.17 (1H, d), 7.14 (1H, d), 6.86 (1H, d), 4.58 (2H, q), 3.62 (2H, q), 3.4 (1H, broad s), 3.13 (1H, t), 2.82 (2H, broad s), 2.45 (1H, broad), 1.99 (1H, broad, s), 1.48 (6H, 2 x s) and 1.24 (3H, broad s).

25

**Example 104****[4-chloro-2-[[[(3S)-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid**

- 5 The title compound was prepared by the methods of example 89 part (f) and example 89 part (g) using the product of example 89 part (e) and 4-methoxy-benzeneacetyl chloride.
- MS: APCI (-ve): 447 (M-H)
- <sup>1</sup>H NMR (CDCl<sub>3</sub> at 50 °C) δ 8.36 (1H, broad s), 7.24 (2H, m), 7.07 (2H, m), 6.82 (3H, m), 4.58 (2H, q), 4.45 (1H, broad, s), 3.95 (1H, broad s), 3.78 (3H, s), 3.61 (2H, d), 3.59 (2H, q),
- 10 3.35 (1H, broad s), 2.97 (1H, d), 2.87 (1H, d), 2.42 (1H, d), 2.16 (1H, t) and 1.28 (3H, d).

**Example 105****[2-[[[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**

- 15 **a) (2S)-4-[[[2-[2-(1,1-dimethylethoxy)-2-oxoethoxy]-5-(trifluoromethyl)phenyl] methyl]-2-methyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

The sub-title compound was prepared by the method of example 89 part (d) using the products of example 1 part (d) and example 89 part (c).

- 20 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.59 (1H, d), 7.53 (1H, dd), 6.83 (1H, d), 4.76 (2H, s), 4.2 (1H, broad s), 3.82 (1H, d), 3.61 (2H, s), 3.13 (1H, t), 2.78 (1H, d), 2.62 (1H, d), 2.09 (2H, m), 1.46 (9H, m) and 1.29 (3H, d).

**b) [2-[[[(3S)-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid, 1,1-dimethylethyl ester, TFA salt**

The sub-title compound was prepared by the method of example 89 part (e) using the product of part (a).

5

**c) [2-[[[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**

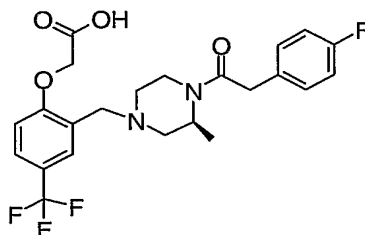
The title compound was prepared by the methods of examples 89 part (f) and example 89 part (g) using 4-chlorophenylacetyl chloride and the product of part (b).

10 MS: APCI (-ve): 483 (M-H)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  8.87 (1H, broad s), 7.55 (2H, s), 7.26 (2H, d), 7.13 (2H, d), 6.98 (1H, d), 4.67 (2H, q), 4.48 (1H, broad s), 4.00 (1H, broad s), 3.73 (2H, q), 3.66 (2H, s), 3.36 (1H, broad s), 3.00 (1H, d), 2.89 (1H, d), 2.45 (1H, d), 2.25 (1H, d) and 1.31 (3H, d).

15 **Example 106**

**[2-[[[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid**



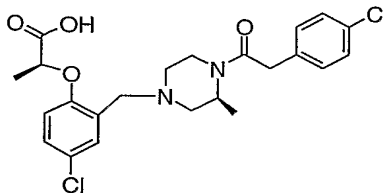
The title compound was prepared by the methods of examples 89 part (f) and example

20 89 part (g) using 4-chlorophenylacetyl chloride and the product of example 105 part (b).

MS: APCI (-ve): 467 (M-H)

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  7.54 (2H, m), 7.37 (1H, broad s), 7.16 (2H, m), 6.98 (3H, m), 4.66 (2H, q), 4.61 (1H, broad s), 3.87 (1H, broad s), 3.73 (2H, q), 3.66 (2H, s), 3.36 (1H, broad s), 3.00 (1H, d), 2.90 (1H, d), 2.45 (1H, d), 2.25 (1H, t) and 1.28 (3H, d).

25

**Example 107****(2S)-2-[4-chloro-2-[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid**

5

**a) (2S)-2-(4-chloro-2-formylphenoxy)-propanoic acid, methyl ester**

Methyl (*R*)-(+)-lactate (3.33 g) and acetonitrile (16.7 ml) were charged to a flask and the resulting solution cooled to  $-5^{\circ}\text{C}$ . Triethylamine (4.9 ml) was added. Triethylamine hydrochloride (0.31 g) was added. A solution of *para*-toluenesulfonyl chloride (5.8 g) dissolved in acetonitrile (16.7 ml) was added dropwise to the reaction mixture (over 40 mins), maintaining the temperature below  $5^{\circ}\text{C}$ . After complete addition a precipitate formed which was filtered. The filtrate was diluted further with acetonitrile (55 ml), to give (2*R*)-2-(4-methylphenoxy)-propanoic acid, methyl ester. The solution was treated with potassium carbonate (5 g) and 5-chloro-2-hydroxy benzaldehyde. The reaction mixture was heated at  $50^{\circ}\text{C}$  for 32 h, then cooled to  $20^{\circ}\text{C}$ , diluted with water (100 ml) and extracted with tert-butyl methyl ether (250 ml). The organic phase was washed (brine), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. The residue was purified by chromatography (silica, 5-20% EtOAc/hexane as eluent) to give the sub-title compound (5.3 g).

$^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  10.49 (1H, s), 7.81 (1H, s), 7.44 (1H, d), 6.8 (1H, d), 4.87 (1H, q), 3.77 (3H, s), and 1.7 (3H, d).

**b) (2S)-4-[[5-chloro-2-[(1S)-2-methoxy-1-methyl-2-oxoethoxy]phenyl]methyl]-2-methyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

The product of part (a) and the product of example 89 part (c) were dissolved in methanol and excess  $\text{MgSO}_4$  was added. Sodium triacetoxy borohydride (1.5 g) was added. After 2 h further sodium triacetoxy borohydride (1.5 g) was added and stirred for 1 h. Sodium triacetoxy borohydride (0.5 g) was added then, methanol was evaporated *in vacuo*. The residue was diluted with water and extracted (EtOAc x 3), dried ( $\text{MgSO}_4$ ) then concentrated *in vacuo*. Purified by chromatography (silica, using 3:1 hexane/ether as eluent) to give the sub-title compound (0.85 g).

MS: ESI (-ve): 426 (M-H)

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.43 (1H, d), 7.11 (1H, dd), 6.64 (1H, d), 4.74 (1H, q), 4.25-4.16 (1H, m), 3.82 (1H, d), 3.74 (3H, s), 3.53 (2H, s), 3.13 (1H, dt), 2.77 (1H, d), 2.63 (1H, d), 2.24 (1H, dd), 2.1 (1H, dt), 1.61 (3H, d), 1.46 (9H, s) and 1.7 (3H, d).

5

**c) (2S)-2-[4-chloro-2-[(3S)-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester, TFA salt**

The sub-title compound was prepared by the method of example 89 part (e) using the product of part (b).

10

**d) (2S)-2-[4-chloro-2-[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of part (c) and 4-chlorophenylacetyl chloride.

15 MS: ESI (+ve): 478 (M+H)

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.4 (1H, s), 7.34-7.25 (2H, m), 7.23-7.07 (3H, m), 6.62 (1H, d), 4.84-4.68 (1H, m), 4.73 (1H, q), 4.43 (1H, d), 4.06 (1H, s), 3.73 (3H, s), 3.68 (2H, s), 3.51 (2H, s), 3.33 (1H, t), 3.01 (1H, t), 2.84 (1H, d), 2.78-2.6 (1H, m), 1.6 (3H, d) and 1.28 (3H, d).

20

**e) (2S)-2-[4-chloro-2-[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid**

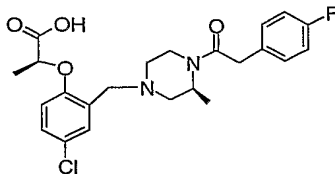
The product from part d) (50 mg) was dissolved in THF (2 ml) and methanol (2 ml). 1M NaOH (0.1 ml) was added and the reaction mixture was stirred for 2.5 days, then concentrated *in vacuo*. The residue was triturated with ether to give the title compound (41

25 mg).

MS: APCI (+ve): 465 (M+H)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.35 (2H, d), 7.3-7.19 (3H, m), 7.11 (1H, dd), 6.74 (1H, d), 4.6-4.48 (1H, m), 4.24-4.1 (2H, m), 3.68 (2H, s), 3.46 (2H, s), 3.32-3.25 (1H, m), 2.96-2.66 (2H, m), 2.13-2 (1H, m), 1.94 (1H, t), 1.33 (3H, d) and 1.26-1.13 (3H, m)

30

**Example 108****(2S)-2-[4-chloro-2-[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid**

5 **a) (2S)- 2-[4-chloro-2-[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and 4-fluorophenylacetyl chloride.

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.38 (1H, d), 7.31-7.15 (2H, m), 7.12 (1H, dd), 7.07-6.94 (2H, m), 6.62  
 10 (1H, d), 4.87-4.71 (1H, m), 4.73 (1H, qs), 4.00-3.97 (1H, m), 3.91 (3H, s), 3.65-3.51 (2H, m), 3.43-3.27 (1H, m), 2.92-2.61 (2H, m), 2.16-2.06 (1H, m) 1.59 (3H, d) and 1.27 (3H, d).

**b) (2S)-2-[4-chloro-2-[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid**

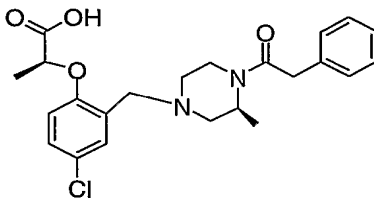
15 The title compound was prepared by the method of example 107 part (e) using the product of part (a).

MS: APCI (+ve): 449 (M+H)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.37 (1H, d), 7.24 (3H, dd), 7.12 (2H, t), 6.9 (1H, d),  
 4.77 (1H, q), 4.63-4.52 (1H, m), 4.27-4.17 (1H, m), 3.81-3.71 (1H, m), 3.68 (2H, s), 3.62-3.49  
 20 (2H, m), 2.88-2.72 (2H, m), 2.21 (1H, dd), 2.11-1.99 (1H, m), 1.46 (3H, d) and 1.25-1.13 (3H, m).

**Example 109**

25 **(2S)-2-[4-chloro-2-[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methoxy]phenoxy]-propanoic acid**



**a) (3S)-3-methyl-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

Triethylamine (2.85 ml) was added to a solution of (S)-2-methyl piperazine (1 g) in methanol (25 ml) followed by portion wise addition of BOC anhydride (2.18 g). The reaction mixture was stirred for 17 h, concentrated *in vacuo*. The residue was partitioned between  
5 water and ethyl acetate. The organic phase was dried (MgSO<sub>4</sub>), and then concentrated *in vacuo*. The residue was purified by chromatography (silica, ethyl acetate as eluent, then 90:10:1 mixture of ethyl acetate: methanol: ammonia) to give the sub-title compound (1.3 g).  
<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 4.03-3.85 (2H, m), 2.95 (1H, d), 2.86-2.65 (3H, m), 2.5-2.3 (1H, m), 1.48 (9H, s) and 1.05 (3H, d).

**b) (3S)-3-methyl-4-(phenylacetyl)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

The product from part a) (0.734 g), sodiumhydrogen carbonate (0.769 g), DCM (6 ml) and water (6 ml) were charged to a flask and stirred vigorously. Phenylacetyl chloride (775 μl) was added dropwise, then stirred for 4 h, diluted with DCM, washed with water, then with  
15 brine. The organic fractions were dried (MgSO<sub>4</sub>), then concentrated *in vacuo* to give the sub-title compound (1.07 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.32 (2H, t), 7.28-7.18 (3H, m), 4.87-4.76 (1H, m), 4.49-4.38 (1H, m), 4.1-3.92 (1H, m), 3.87-3.68 (2H, m), 3.01-2.81 (2H, m), 2.8-2.68 (1H, m), 2.62-2.5 (1H, m), 1.45 (9H, s) and 1.18-1.05 (3H, m).

**c) (2S)-2-methyl-1-(phenylacetyl)-piperazine**

TFA (5 ml) was added to a solution of the product from part b) (1.07 g) in DCM (10 ml) and stirred for 1 h. Toluene was added and the reaction mixture was concentrated *in vacuo*, and then triturated with ether to give the sub-title compound (0.99 g).

**d) (2S)-2-[4-chloro-2-[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 107 part (b) using the product of example 107 part (a) (0.25 g) and the product of part c) (0.34 g).

30 MS: ESI (+ve): 445 (M+H)

**e) (2S)-2-[4-chloro-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-propanoic acid**

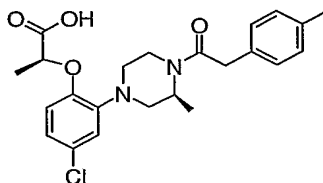
The title compound was prepared by the method of example 107 part (e) using the product of part (d).

5 MS: APCI (+ve): 431 (M+H)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.34-7.17 (6H, m), 7.1 (1H, dd), 6.73 (1H, t), 4.6-4.51 (1H, m), 4.24-4.1 (2H, m), 3.73 (1H, d), 3.47-3.33 (2H, m), 3.24-3.15 (1H, m), 2.91-2.59 (3H, m), 2.04 (1H, dd), 1.91 (1H, t), 1.33 (3H, d) and 1.21-1.14 (3H, m).

10 **Example 110**

**(2S)-2-[4-chloro-2-[[[(3S)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid**



**a) (2S)-2-[4-chloro-2-[[[(3S)-3-methyl-4-[(4-methylphenyl)acetyl]-1-**

15 **piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and 4-methylphenylacetyl chloride.

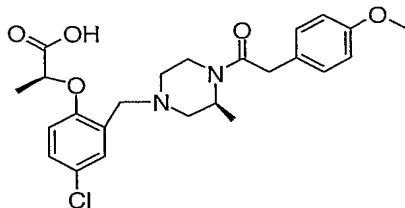
MS: ESI (+ve): 459 (M+H)

20 **b) (2S)-2-[4-chloro-2-[[[(3S)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid**

The title compound was prepared by the method of example 107 part (e) using the product of part (a). The product was purified by reverse phase HPLC.

MS: APCI (+ve): 445 (M+H)

25 <sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.42-7.35 (2H, m), 7.20-7.06 (5H, m), 5-3.9 (3H, m), 3.83-3.67 (3H, m), 3.64-3.39 (2H, m), 3.26-3.03 (2H, m), 2.8-2.66 (2H, m), 2.31 (3H, s), 1.58 (2H, s), 3.62-3.49 (2H, m), 2.88-2.72 (2H, m), 2.21 (1H, dd), 2.11-1.99 (1H, m), 1.46 (3H, d) and 1.41-1.25 (3H, m).

**Example 111****(2S)-2-[4-chloro-2-[[[(3S)-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid**

5 **a) (2S)-2-[4-chloro-2-[[[(3S)-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and 4-methoxyphenylacetyl chloride.

MS: ESI (+ve): 475 (M+H)

10

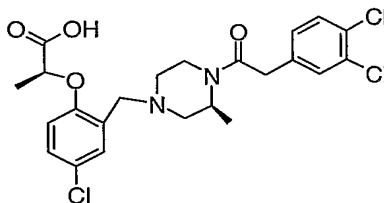
**b) (2S)-2-[4-chloro-2-[[[(3S)-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid**

The title compound was prepared by the method of example 107 part (e) using the product of part (a). The product was purified by reverse phase HPLC.

15 MS: APCI (-ve): 459 (M-H)

<sup>1</sup>H NMR (CD<sub>3</sub>OD) δ 7.37 (2H, d), 7.22-7.08 (3H, m), 6.88 (2H, d), 5.03-4.85 (2H, m), 4.59-4.41 (2H, m), 4.02-3.88 (1H, m), 3.76 (3H, s), 3.73 (2H, s), 3.64-3.37 (2H, m), 3.20-3.01 (2H, m), 2.69 (1H, t), 1.57 (3H, d), and 1.38-1.29 (3H, m).

20 **Example 112**

**(2S)-2-[4-chloro-2-[[[(3S)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid**

25 **a) 3,4-dichlorophenyl acetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 3,4-dichlorophenyl acetic acid.

**b) (2S)-2-[4-chloro-2-[[[(3S)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and the product of part (a).

MS: ESI (+ve): 514.9 (M+H)

**c) (2S)-2-[4-chloro-2-[[[(3S)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid**

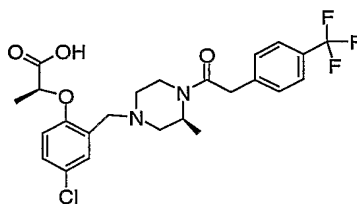
The title compound was prepared by the method of example 107 part (e) using the product of part (a). The product was purified by reverse phase HPLC.

MS: APCI (-ve): 499 (M-H)

<sup>1</sup>H NMR (CD<sub>3</sub>OD) δ 7.49-7.33 (4H, m), 7.22-7.07 (2H, m), 5.03-4.81 (2H, m), 4.59-4.38 (2H, m), 4.03-3.57 (4H, m), 3.54-3.39 (1H, m), 3.13 (2H, d), 2.85-2.68 (1H, m), 1.59 (3H, d), and 1.46-1.33 (3H, m).

**Example 113**

**(2S)-2-[4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid**



**a) 4-(trifluoromethyl)-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 4-trifluoromethylphenyl acetic acid.

**b) (2S)-2-[4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and the product of part (a).

MS: ESI (+ve): 513 (M+H)

**c) (2S)-2-[4-chloro-2-[(3S)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid**

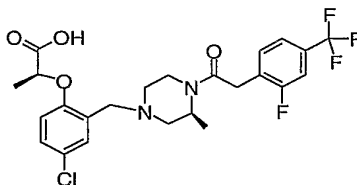
The title compound was prepared by the method of example 107 part (e) using the product of part (a). The product was purified by reverse phase HPLC.

5 MS: APCI (-ve): 497 (M-H)

<sup>1</sup>H NMR (CD<sub>3</sub>OD) δ 7.63 (2H, d), 7.50-7.34 (4H, m), 7.11 (2H, d), 5.05-4.87 (2H, m), 4.61-4.4 (2H, m), 4.07-3.82 (3H, m), 3.77 (1H, d), 3.72-3.58 (1H, m), 3.14 (2H, d), 2.84-2.69 (1H, m), 1.59 (3H, d) and 1.46-1.39 (3H, d).

10 **Example 114**

**(2S)-2-[4-chloro-2-[(3S)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid**



**a) 2-fluoro-4-(trifluoromethyl)-benzeneacetyl chloride**

15 The sub-title compound was prepared by the method of example 90 part (a) using 2-fluoro-4-trifluoromethylphenyl acetic acid.

**b) (2S)-2-[4-chloro-2-[(3S)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid methyl ester**

20 The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and the product of part (a).

MS: ESI (+ve): 531 (M+H)

**c) (2S)-2-[4-chloro-2-[(3S)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid**

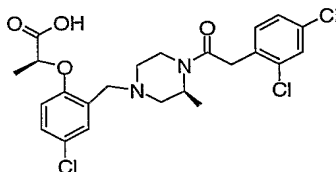
25 The title compound was prepared by the method of example 107 part (e) using the product of part (a).

MS: APCI (-ve): 515 (M-H)

$^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ )  $\delta$  7.51-7.36 (5H, m), 7.14 (1H, d), 4.97 (1H, q), 4.67-4.41 (2H, m), 4.11-3.98 (1H, m), 3.95-3.86 (2H, m), 3.85-3.7 (2H, m), 3.54 (1H, d), 3.24-3.16 (2H, m), 2.98-2.82 (1H, m), 1.6 (3H, d) and 1.48-1.37 (3H, m).

5 **Example 115**

**(2S)-2-[4-chloro-2-[(3S)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methoxy]-propanoic acid**



**a) 2,4-dichloro-benzeneacetyl chloride**

10 The sub-title compound was prepared by the method of example 90 part (a) using 2,4-dichlorophenyl acetic acid.

**b) (2S)-2-[4-chloro-2-[(3S)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methoxy]-propanoic acid, methyl ester**

15 The sub-title compound was prepared by the method of example 89 part f) using the product of example 107 part c) and the product of part a).

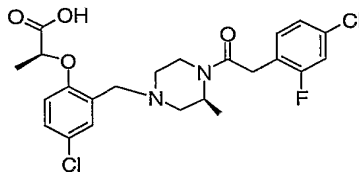
MS: ESI (+ve): 515 (M+H)

**c) (2S)-2-[4-chloro-2-[(3S)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methoxy]-propanoic acid**

20 The title compound was prepared by the method of example 107 part (e) using the product of part (a). The product was purified by reverse phase HPLC.

MS: APCI (-ve): 499 (M-H)

$^1\text{H}$  NMR ( $\text{CD}_3\text{OD}$ )  $\delta$  7.50-7.37 (2H, m), 7.37-7.22 (3H, m), 7.08 (1H, d), 4.99-4.83 (1H, m), 4.06-3.91 (1H, m), 3.90-3.61 (4H, m), 3.50-3.34 (1H, m), 3.14 (1H, d), 3.07 (1H, d), 2.86-2.65 (1H, m), 1.59 (3H, d) and 1.46-1.33 (3H, m).

**Example 116****(2S)-2-[4-chloro-2-[(3S)-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methoxy]-propanoic acid**5 **a) 4-chloro-2-fluoro-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 4-chloro-2-fluoro-phenyl acetic acid.

10 **b) (2S)-2-[4-chloro-2-[(3S)-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methoxy]-propanoic acid methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and the product of part (a).

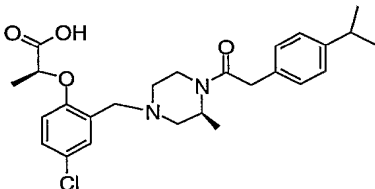
MS: ESI (+ve): 497 (M+H)

15 **c) (2S)-2-[4-chloro-2-[(3S)-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methoxy]-propanoic acid**

The title compound was prepared by the method of example 107 part (e) using the product of part (a).

MS: APCI (-ve): 481 (M-H)

20 <sup>1</sup>H NMR (CD<sub>3</sub>OD) δ 7.41 (1H, d), 7.36 (1H, dd), 7.25 (1H, t), 7.2-7.15 (2H, m), 7.09 (1H, d), 4.98-4.83 (1H, m), 4.6-4.37 (2H, m), 4.04-3.92 (1H, m), 3.89-3.63 (4H, m), 3.49-3.4 (1H, m), 3.19-3.06 (2H, m), 2.89-2.65 (1H, m), 1.59 (3H, d) and 1.50-1.33 (3H, m).

**Example 117**25 **(2S)-2-[4-chloro-2-[(3S)-3-methyl-4-[[4-(1-methylethyl)phenyl]acetyl]-1-piperazinyl]methoxy]-propanoic acid**

**a) 4-(1-methylethyl)-benzeneacetyl chloride**

The sub-title compound was prepared by the method of example 90 part (a) using 4-isopropylphenyl acetic acid, used directly without characterisation.

5 **b) (2S)-2-[4-chloro-2-[(3S)-3-methyl-4-[[4-(1-methylethyl)phenyl]acetyl]-1-piperazinyl]methoxy]-propanoic acid methyl ester**

The sub-title compound was prepared by the method of example 89 part (f) using the product of example 107 part (c) and the product of part (a).

MS: ESI (+ve): 487 (M+H)

10

**c) (2S)-2-[4-chloro-2-[(3S)-3-methyl-4-[[4-(1-methylethyl)phenyl]acetyl]-1-piperazinyl]methoxy]-propanoic acid**

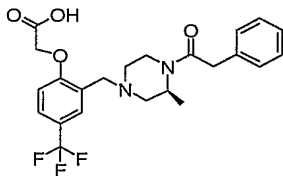
The title compound was prepared by the method of example 107 part (e) using the product of part (a). The product was purified by reverse phase HPLC.

15 MS: APCI (-ve): 471 (M-H)

<sup>1</sup>H NMR (CD<sub>3</sub>OD) δ 7.41-7.28 (2H, m), 7.23-7.11 (4H, m), 7.08 (1H, d), 5.02-4.91 (1H, m), 4.59-4.28 (2H, m), 4.00-3.88 (1H, m), 3.82-3.68 (3H, m), 3.63-3.39 (2H, m), 3.13-3.00 (2H, m), 2.92-2.82 (1H, sept), 2.64 (1H, t), 1.57 (3H, d), 1.39-1.27 (3H, m) and 1.22 (6H, d).

20 **Example 118**

**[2-[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]-4-(trifluoromethyl)methoxy]-acetic acid**



The title compound was prepared by the method of example 89 part (d) using the product of example 109 part (c) and the product of example 1 part d). The ester hydrolysis was carried out by the method of example 88 part (f).

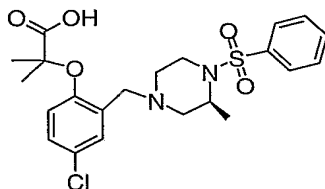
MS: APCI (+ve): 451 (M+H)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.71 (1H, s), 7.56 (1H, d), 7.30 (2H, m), 7.21 (3H, m), 7.05 (1H, d), 4.72 (2H, s), 4.56 (1H, m), 4.22 (1H, m), 3.81-3.52 (1H, m), 3.68 (2H, s), 3.56 (2H, s), 3.23 (1H, m), 2.93-2.59 (2H, m), 2.02 (2H, m) and 1.17 (3H, d).

30

**Example 119****2-[4-chloro-2-[(3S)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methoxy]-2-methyl-propanoic acid**

5

**a) 2-(4-chloro-2-formylphenoxy)-2-methyl-propanoic acid, ethyl ester**

5-chloro-2-hydroxy-benzaldehyde (0.626 g), ethyl-1,2-bromoisobutyrate (0.59 ml), DMF (4 ml) and caesium carbonate (1.3 g) were charged to a flask and heated at 90 °C under  
10 nitrogen for 3 h. The reaction mixture was cooled to room temperature then diluted with ethyl acetate, washed with water, sodium hydrogen carbonate, brine, and then dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to give the sub-title compound (0.679 g).

<sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 10.43 (1H, s), 7.8 (1H, d), 7.39 (1H, dd), 6.76 (1H, d), 4.24 (2H, q), 1.68 (6H, s) and 1.24 (3H, t).

15

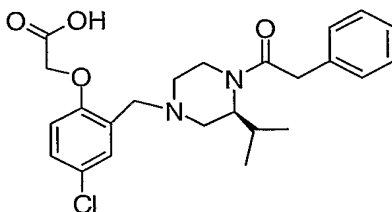
**b) 2-[4-chloro-2-[(3S)-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methoxy]-2-methyl-propanoic acid**

The products of part a) (0.242 g), the product of example 59 part b) (0.248 g) MgSO<sub>4</sub> (0.54 g) and THF (3 ml) were charged to a flask and stirred for 6 h. Sodium triacetoxy  
20 borohydride (0.57 g) was added and stirred for 16 h. The mixture was partitioned between 2M sodium carbonate and ethyl acetate. The organic layer was dried (MgSO<sub>4</sub>) then concentrated *in vacuo*. The residue was purified by SCX resin eluting with acetonitrile, then methanol, finally 7N ammonia in methanol. The basic fractions were concentrated and further purified by chromatography (silica, 50% ether/ isoheaxne as eluent). to give a  
25 colourless oil. The oil (92 mg) was dissolved in THF (2 ml) and treated with 6.25 M NaOH (1 ml). The reaction mixture was stirred for 6 days, quenched with 15 % acetic acid, extracted with ethyl acetate. The organic phase was dried (MgSO<sub>4</sub>) then concentrated *in vacuo*. The residue was purified by reverse phase HPLC to give the title compound (38 mg). MS: APCI (+ve): 467 (M+H)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.8 (2H, d), 7.63 (3H, m), 7.26 (1H, d), 7.17 (1H, dd), 6.75 (1H, d), 3.99 (1H, m), 3.56 (1H, d), 3.42-3.10 (4H, m), 2.68 (1H, d), 2.00 (1H, dd), 1.89 (1H, td), 1.44 (6H, s) and 1.08 (3H, d).

5 **Example 120**

**[4-chloro-2-[[[(3S)-3-(1-methylethyl)-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic acid**



10 **a) (3S)-3-(1-methylethyl)-1-(phenylmethyl)-2,5-piperazinedione**

The sub-title compound was prepared by the method of example 69 part (a) using N-Boc-L-valine.

MS: ESI (+ve): 247 (M+H)

$^1\text{H}$  NMR (DMSO- $d_6$ )  $\delta$  7.39-7.24 (5H, m), 7.01-6.92 (1H, m), 4.76 (1H, d), 4.46 (1H, d), 3.94 (1H, m), 3.83 (2H, d), 2.47 (1H, m), 1.04 (3H, d) and 0.89 (3H, d).

**b) (3S)-3-(1-methylethyl)-1-(phenylmethyl)-piperazine**

The sub-title compound was prepared by the method of example 69 part (b) using the product of part (a).

20 MS: ESI (+ve): 219 (M+H)

**c) (2S)-2-(1-methylethyl)-1-(phenylacetyl)-4-(phenylmethyl)-piperazine**

The sub-title compound was prepared by the method of example 109 part (b) using the product of part (b).

25

**d) (2S)-2-(1-methylethyl)-1-(phenylacetyl)-piperazine**

The sub-title compound was prepared by the method of example 69 part (d) using the product of part (c).

MS: ESI (+ve): 247 (M+H)

30

**e) [4-chloro-2-[[[(3S)-3-(1-methylethyl)-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid**

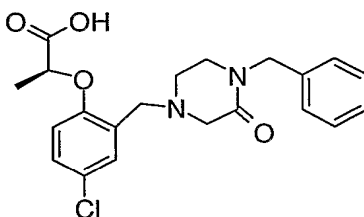
The title compound was prepared by the methods of example 89 part (d) and example 88 part (f) using the product of example part (d) and the product of example 13 part (a). MS:

5 APCI (+ve): 445 (M+H)

<sup>1</sup>H NMR (DMSO-d<sub>6</sub>) δ 7.36 (1H, d), 7.28 (1H, d), 7.25 (5H, m), 6.9 (1H, d), 4.61 (2H, s), 4.35-4.07 (1H, m), 3.8-3.44 (2H, m), 3.49 (2H, s), 3.18-2.67 (3H, m), 2.52-2.4 (1H, m), 2.39-2.27 (1H, m), 2.00-1.78 (2H, m), 0.84 (3H, m), and 0.70 (3H, m).

10 **Example 121**

**(2S)-2-[4-chloro-2-[[3-oxo-4-(phenylmethyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid**



15

**a) 3-oxo-4-(phenylmethyl)-1-piperazinecarboxylic acid, 1,1-dimethylethyl ester**

Sodium hydride (88 mg, 60% wt.) was added portionwise to a solution of 4-BOC-piperazinone (400mg) in DMF (10 ml). The reaction mixture was stirred for 1 h, and then  
20 benzyl bromide (262 μl) was added dropwise and the mixture stirred at room temp for 16 h. The reaction was quenched with methanol and diluted with water, and then extracted with EtOAc. The organic extracts were concentrated *in vacuo* and the residue was purified by chromatography (silica, 20% ether/ hexane as eluent) to give the sub-title compound (429 mg).

25 <sup>1</sup>H NMR (CDCl<sub>3</sub>) δ 7.37-7.24 (5H, m), 4.63 (2H, s), 4.56 (2H, s), 3.58 (2H, t), 3.25 (2H, t) and 1.46 (9H, s).

**b) 1-(phenylmethyl)-2-piperazinone**

The product of part a) (420 mg) was stirred in TFA (10 ml) for 30 min, then  
30 concentrated *in vacuo* to give the sub-title compound as an oil (415 mg).

MS: ESI (+ve): 191 (M+H)

**c) (2S)-2-[4-chloro-2-[[3-oxo-4-(phenylmethyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid, methyl ester**

5 The product of example 107 part (a) (135 mg), the product of part (b) and MgSO<sub>4</sub> (xs) in THF (10 ml) were charged to a flask and heated at 50°C for approximately 16 h. The reaction mixture was cooled to room temperature and sodium triacetoxy borohydride (1 equivalent) added then 0.5 equivalent added after 1 hour. The reaction was stirred for a further 1 hour, then diluted with water, extracted EtOAc (x 3), washed (brine), dried (MgSO<sub>4</sub>)  
10 concentrated *in vacuo*. The residue was purified by chromatography (silica, ether as eluent) to give the sub-title compound (20 mg).

**d) (2S)-2-[4-chloro-2-[[3-oxo-4-(phenylmethyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid**

15 The title compound was prepared by the method of example 107 part (e) using the product of part c).

MS: APCI (-ve): 401 (M-H)

<sup>1</sup>H NMR (CD<sub>3</sub>OD) δ 7.39 (1H, d), 7.37-7.25 (6H, m), 7.04 (1H, d), 4.9-4.84 (1H, m), 4.65 (2H, q), 4.28 (1H, d), 3.82 (1H, d), 3.72 (1H, d), 3.59 (1H, d), 3.52-3.4 (2H, m), 3.24-3.10  
20 (2H, m) and 1.60 (3H, d).

**Pharmacological Data**

**Ligand Binding Assay**

[<sup>3</sup>H]PGD<sub>2</sub> was purchased from Perkin Elmer Life Sciences with a specific activity of  
25 100-210Ci/mmol. All other chemicals were of analytical grade.

HEK cells expressing rhCRTh2 / Gα<sub>16</sub> were routinely maintained in DMEM containing 10% Foetal Bovine Serum (HyClone), 1mg/ml geneticin, 2mM L-glutamine and 1% non-essential amino acids. For the preparation of membranes, the adherent transfected HEK cells were grown to confluence in two layer tissue culture factories (Fisher, catalogue number  
30 TKT-170-070E). Maximal levels of receptor expression were induced by addition of 500mM sodium butyrate for the last 18 hours of culture. The adherent cells were washed once with phosphate buffered saline (PBS, 50ml per cell factory) and detached by the addition of 50ml per cell factory of ice-cold membrane homogenisation buffer [20mM HEPES (pH 7.4),

0.1mM dithiothreitol, 1mM EDTA, 0.1mM phenyl methyl sulphonyl fluoride and 100 $\mu$ g/ml bacitracin]. Cells were pelleted by centrifugation at 220xg for 10 minutes at 4°C, re-suspended in half the original volume of fresh membrane homogenisation buffer and disrupted using a Polytron homogeniser for 2 x 20 second bursts keeping the tube in ice at all times. Unbroken cells were removed by centrifugation at 220xg for 10 minutes at 4°C and the membrane fraction pelleted by centrifugation at 90000xg for 30 minutes at 4°C. The final pellet was re-suspended in 4 ml of membrane homogenisation buffer per cell factory used and the protein content determined. Membranes were stored at -80°C in suitable aliquots.

All assays were performed in Corning clear bottomed, white 96-well NBS plates (Fisher). Prior to assay, the HEK cells membranes containing CRTh2 were coated onto SPA PVT WGA beads (Amersham). For coating membranes were incubated with beads at typically 25 $\mu$ g membrane protein per mg beads at 4°C with constant agitation overnight. (The optimum coating concentrations were determined for each batch of membranes) The beads were pelleted by centrifugation (800xg for 7minutes at 4°C), washed once with assay buffer (50mM HEPES pH 7.4 containing 5mM magnesium chloride) and finally re-suspended in assay buffer at a bead concentration of 10mg/ml.

Each assay contained 20 $\mu$ l of 6.25nM [ $^3$ H]PGD<sub>2</sub>, 20 $\mu$ l membrane saturated SPA beads both in assay buffer and 10 $\mu$ l of compound solution or 13,14-dihydro-15-keto prostaglandin D<sub>2</sub> (DK-PGD<sub>2</sub>, for determination of non-specific binding, Cayman chemical company).

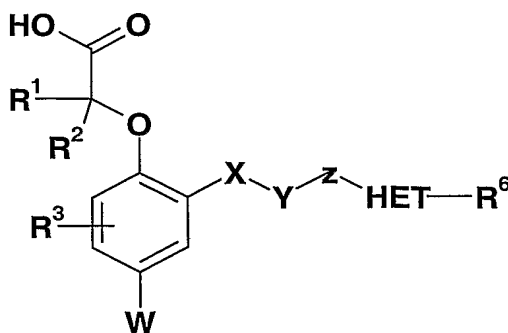
Compounds and DK-PGD<sub>2</sub> were dissolved in DMSO and diluted in the same solvent to 100x the required final concentration. Assay buffer was added to give a final concentration of 10% DMSO (compounds were now at 10x the required final concentration) and this was the solution added to the assay plate. The assay plate was incubated at room temperature for 2 hours and counted on a Wallac Microbeta liquid scintillation counter (1 minute per well).

Compounds of formula (I) have an IC<sub>50</sub> value of less than (<) 10 $\mu$ M.

Specifically Example 42 has a pIC<sub>50</sub> value of 6.88, example 7 has a pIC<sub>50</sub> value of 7.05, example 57 has a pIC<sub>50</sub> value of 8.3 and example 91 has a pIC<sub>50</sub> value of 7.8.

## CLAIMS

1. A compound of formula (I) or a pharmaceutically acceptable salt thereof:



(I)

in which:

- $R^1$  and  $R^2$  independently represent a hydrogen atom, halogen,  $C_2$ - $C_6$  alkenyl,  $C_2$ - $C_6$  alkynyl,  $C_3$ - $C_7$  cycloalkyl or a  $C_{1-6}$ alkyl group, the latter four groups being optionally substituted by one or more substituents independently selected from halogen,  $C_3$ - $C_7$  cycloalkyl,  $NR^9R^{10}$ ,  $OR^8$ ,  $S(O)_nR^7$  (where n is 0, 1 or 2);  
or

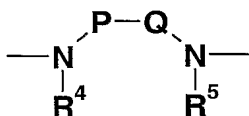
- $R^1$  and  $R^2$  together can form a 3-8 membered ring optionally containing one or more atoms selected from O, S,  $NR^{11}$  and itself optionally substituted by one or more  $C_1$ - $C_3$  alkyl or halogen;

- W is halogen, cyano, nitro,  $SO_2R^7$ ,  $SO_2NR^9R^{10}$ ,  $OR^8$ , or  $C_{1-6}$ alkyl, the latter being optionally substituted by one or more substituents independently selected from halogen,  $OR^8$  and  $NR^7R^8$ ,  $S(O)_nR^5$  where n is 0, 1 or 2.

- $R^3$  is one or more substituents independently selected from hydrogen, halogen, CN, nitro,  $SO_2R^7$ ,  $OR^8$ ,  $SR^7$ ,  $SOR^7$ ,  $SO_2NR^9R^{10}$ ,  $CONR^9R^{10}$ ,  $NR^9R^{10}$ ,  $NR^{11}SO_2R^7$ ,  $NR^{11}CO_2R^7$ ,  $NR^{11}COR^7$  or  $C_{1-6}$ alkyl, the latter being optionally substituted by one or more substituents independently selected from halogen,  $OR^8$  and  $NR^9R^{10}$ ,  $S(O)_nR^7$  where n is 0, 1 or 2;

- X represents a bond, or  $C_1$ - $C_6$  alkyl, optionally substituted by one or more substituents independently selected from halogen,  $C_1$ - $C_6$  alkyl the latter being optionally substituted by one or more substituents independently selected from halogen,  $OR^6$  and  $NR^7R^8$ ,  $S(O)_nR^5$  where n is 0, 1 or 2;

Y represents a diamine of the following type:-



5  $\text{R}^4$  and  $\text{R}^5$  independently represent hydrogen,  $\text{SO}_2\text{R}^7$ ,  $\text{C(O)R}^7$ ,  $\text{CO}_2\text{R}^7$  and  $\text{C}_1\text{-C}_6$  alkyl, the latter being optionally substituted by one or more substituents independently selected from aryl, heteroaryl, halogen,  $\text{OR}^8$  and  $\text{NR}^9\text{R}^{10}$ ,  $\text{S(O)}_n\text{R}^7$  where n is 0, 1 or 2;  $\text{R}^4$  and  $\text{R}^5$  are joined together or one of  $\text{R}^4$  and  $\text{R}^5$  is joined onto P or Q to form a saturated heterocyclic 3-10 membered ring with, 1 or 2 endocyclic nitrogen atoms;

10 P and Q independently represent,  $\text{C}_1\text{-C}_6$  alkyl optionally substituted by one or more substituents independently selected from (=O), halogen,  $\text{OR}^8$  and  $\text{NR}^9\text{R}^{10}$ ,  $\text{S(O)}_n\text{R}^7$  (where n is 0, 1 or 2),  $\text{C}_1\text{-C}_6$  alkyl,  $\text{C}_3\text{-C}_6$  cycloalkyl, aryl or heteroaryl (the latter two being optionally substituted by one or more substituents independently selected from halogen,  $\text{OR}^8$  and  $\text{NR}^9\text{R}^{10}$ ,  $\text{CONR}^9\text{R}^{10}$ ,  $\text{S(O)}_n\text{R}^7$  where n is 0, 1 or 2);

15 Z represents a bond,  $(\text{CR}^{12})_n\text{-C(O)}$ ,  $(\text{CR}^{12})_n\text{-S(O)}_n$ ,  $\text{C(O)}(\text{CR}^{12})_n$ , or  $\text{S(O)}_2(\text{CR}^{12})_n$ ,  $\text{S(O)}_2\text{N}(\text{CR}^{12})_n$ , where n= 0, 1 or 2;.

HET represents aryl or heteroaryl;

$\text{R}^6$  represents one or more substituents independently selected from hydrogen, halogen, CN, nitro,  $\text{COR}^7$ ,  $\text{CO}_2\text{R}^8$ ,  $\text{SO}_2\text{R}^7$ ,  $\text{OR}^8$ ,  $\text{SR}^8$ ,  $\text{SOR}^7$ ,  $\text{SO}_2\text{NR}^9\text{R}^{10}$ ,  $\text{CONR}^9\text{R}^{10}$ ,  $\text{NR}^9\text{R}^{10}$ ,  
20  $\text{NR}^8\text{SO}_2\text{R}^7$ ,  $\text{NR}^8\text{CO}_2\text{R}^8$ ,  $\text{NR}^8\text{COR}^7$ ,  $\text{NR}^8\text{CONR}^9\text{R}^{10}$ ,  $\text{NR}^8\text{SO}_2\text{NR}^9\text{R}^{10}$ , aryl, heteroaryl,  $\text{C}_2\text{-C}_6$  alkenyl,  $\text{C}_2\text{-C}_6$  alkynyl,  $\text{C}_3\text{-C}_7$  cycloalkyl or  $\text{C}_{1-6}$ alkyl, the latter four groups being optionally substituted by one or more substituents independently selected from halogen,  $\text{C}_3\text{-C}_7$  cycloalkyl, CN,  $\text{OR}^8$ ,  $\text{NR}^9\text{R}^{10}$ ,  $\text{S(O)}_n\text{R}^7$  (where n is 0, 1 or 2),  $\text{CONR}^9\text{R}^{10}$ ,  $\text{NR}^8\text{COR}^7$ ,  $\text{SO}_2\text{NR}^9\text{R}^{10}$  and  $\text{NR}^8\text{SO}_2\text{R}^7$ ;

25  $\text{R}^7$  represents a  $\text{C}_1\text{-C}_6$  alkyl, an aryl or a heteroaryl group all of which may be optionally substituted by halogen atoms,  $\text{OR}^8$ ,  $\text{NR}^{14}\text{R}^{15}$ ;

$\text{R}^8$  represents hydrogen,  $\text{C}_1\text{-C}_6$ , alkyl, an aryl or a heteroaryl group all of which may be optionally substituted by halogen atoms,  $\text{OR}^8$ ,  $\text{NR}^{14}\text{R}^{15}$ ;

$\text{R}^9$  and  $\text{R}^{10}$  independently represent hydrogen,  $\text{C}_3\text{-C}_7$  cycloalkyl or  $\text{C}_{1-6}$ alkyl, the latter  
30 two groups being optionally substituted by one or more substituents independently selected from halogen,  $\text{C}_3\text{-C}_7$  cycloalkyl,  $\text{OR}^6$  and  $\text{NR}^{14}\text{R}^{15}$ ,  $\text{S(O)}_n\text{R}^6$  (where n = 0,1 or 2),  $\text{CONR}^7\text{R}^8$ ,  $\text{NR}^6\text{COR}^7$ ,  $\text{SO}_2\text{NR}^7\text{R}^8$  and  $\text{NR}^6\text{SO}_2\text{R}^5$ ;

or

R<sup>9</sup> and R<sup>10</sup> together with the nitrogen atom to which they are attached can form a 3-8 membered saturated heterocyclic ring optionally containing one or more atoms selected from O, S(O)<sub>n</sub> (where n = 0,1 or 2), NR<sup>13</sup>, and itself optionally substituted by halogen or C<sub>1-3</sub> alkyl;

5 R<sup>11</sup> represents a hydrogen atom, C(O)R<sup>9</sup>, C<sub>1-6</sub> alkyl an aryl or a heteroaryl group (the latter three can be optionally substituted by halogen);

R<sup>12</sup> represents one or more from hydrogen, or a C<sub>1-6</sub>alkyl group, the latter being optionally substituted by one or more substituents independently selected from halogen, C<sub>3-7</sub> cycloalkyl, NR<sup>14</sup>R<sup>15</sup>, OR<sup>8</sup>, S(O)<sub>n</sub>R<sup>7</sup> (where n is 0, 1 or 2);

10 R<sup>13</sup> represent hydrogen, C<sub>1-4</sub> alkyl, -COC<sub>1-4</sub> alkyl, COYC<sub>1-4</sub>alkyl where Y is O or NR<sup>7</sup>; and

R<sup>14</sup> and R<sup>15</sup> independently represent hydrogen, C<sub>1-4</sub> alkyl

or

R<sup>14</sup> and R<sup>15</sup> together with the nitrogen atom to which they are attached can form a 3-8 membered saturated heterocyclic ring optionally containing one or more atoms selected from  
15 O, S(O)<sub>n</sub> (where n = 0,1 or 2), NR<sup>13</sup>, and itself optionally substituted by halogen or C<sub>1-3</sub> alkyl.

2. A compound according to claim 1 in which Y is piperizine, alkyl substituted piperizine (such as methyl, ethyl or propyl piperizine), piperazinone, imidazolidine,  
20 homopiperazine, aminopyrrolidine, aminoazetidine and aminopiperidine.

3. A compound according to claim 1 or 2 in which W is halogen, CF<sub>3</sub>, CN or C<sub>1-6</sub>alkyl.

4. A compound according to any one of claims 1 to 3 in which R<sup>1</sup> and R<sup>2</sup> are  
25 independently hydrogen or methyl.

5. A compound according to any one of claims 1 to 4 in which R<sup>3</sup> is hydrogen or halogen.

6. A compound according to any one of claims 1 to 5 in which X is a bond or CH<sub>2</sub>;  
30

7. A compound according to any one of claims 1 to 6 in which the group Z is SO<sub>2</sub>, SO<sub>2</sub>CH<sub>2</sub>, C(O)CH<sub>2</sub> C(O)C(Me)<sub>2</sub>, C(O) or C(O)CH<sub>2</sub>CH<sub>2</sub>.

8. A compound according to any one of claims 1 to 7 in which R<sup>6</sup> is one or more substituents selected from halogen, hydrogen, C<sub>1</sub>-C<sub>6</sub> alkyl (optionally substituted by one or more halogen atoms), alkoxy (alkyl group is optionally substituted by halogen atoms), nitro, cyano or SO<sub>2</sub>alkyl

5

9. A compound according to any one of claims 1 to 8 selected from:

[2-[4-[(4-Fluorophenyl)sulfonyl]-1-piperazinyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[4-[[4-(4-cyanophenyl)sulfonyl]-1-piperazinylmethyl]]-4-(trifluoromethyl)phenoxy]-acetic

10 acid;

[2-[[4-[(2-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[[4-[(2-methylphenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

15 [2-[[4-[(4-nitrophenyl)sulfonyl]-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[[4-[(4-fluorophenyl)sulfonyl]hexahydro-1*H*-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[hexahydro-4-[[4-(methoxyphenyl)sulfonyl]-1*H*-1,4-diazepin-1-yl]methyl]-4-

20 (trifluoromethyl)phenoxy]-acetic acid;

[2-[[hexahydro-4-(phenylsulfonyl)-1*H*-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[[4-[(4-cyanophenyl)sulfonyl]hexahydro-1*H*-1,4-diazepin-1-yl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

25 [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid;

[4-chloro-2-[[4-[(4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[4-[(4-chlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[4-[[4-(trifluoromethyl)phenyl]methyl]sulfonyl]-1-piperazinyl]phenoxy]-acetic acid;

30 [4-chloro-2-[[4-[[4-(trifluoromethoxy)phenyl]methyl]sulfonyl]-1-piperazinyl]phenoxy]-acetic acid;

[4-chloro-2-[4-[[4-(methylsulfonyl)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;

- [4-chloro-2-[[4-[(3-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[[3-(trifluoromethyl)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(3-chlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
5 [4-chloro-2-[[4-[[3-(trifluoromethoxy)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[[3-(difluoromethoxy)phenyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(3-chloro-4-fluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic  
10 acid;  
[4-chloro-2-[[4-[(3,4-dichlorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(3,4-difluorophenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[[2-nitrophenyl]methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
15 [4-chloro-2-[[4-[[3-chlorophenyl]methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[4-[[4-chlorophenyl]methyl]sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[2-[[4-(phenylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;  
20 [4-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-Chloro-2-[[4-(1-oxo-3-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[3-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[2-Chloro-2-[[4-[(4-chlorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[1-[4-(phenylsulfonyl)-1-piperazinyl]ethyl]phenoxy]-acetic acid trifluoroacetate  
25 salt;  
[2-[1-(4-benzoyl-1-piperazinyl)ethyl]-4-chlorophenoxy]-acetic acid, trifluoroacetate salt;  
[4-chloro-2-[[[1-[(phenylmethyl)sulfonyl]-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid;  
[4-chloro-2-[[[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid;  
30 [4-chloro-2-[4-(phenylsulfonyl)-1-piperazinyl]phenoxy]-acetic acid;  
[4-chloro-2-[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]phenoxy]-acetic acid;  
[4-chloro-2-[4-(phenylacetyl)-1-piperazinyl]phenoxy]-acetic acid;  
[2-[(4-benzoyl-1-piperazinyl)methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[2-[[4-(2-thienylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

[4-Chloro-2-[[4-[(4-fluorophenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[4-[(4-methylphenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[4-[(3-methylphenyl)methyl]sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[4-[(2-pyridinylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy] acetic acid;

[4-Chloro-2-[[4-[(3-pyridinylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy] acetic acid;

10 [4-Chloro-2-[[4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;

[4-Chloro-2-[[4-[(4-fluorophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;

[4-Chloro-2-[[4-[(4-methoxyphenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;

[4-Chloro-2-[[4-[(3-pyridinylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid;

[4-Chloro-2-[[4-[(4-cyanophenyl)acetyl]-1-piperazinyl]methyl]phenoxy]acetic acid;

15 [4-Chloro-2-[[2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy] acetic acid;

[4-Chloro-2-[[2-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[2-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic

20 acid;

[4-Chloro-2-[[3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]acetic acid;

[4-Chloro-2-[[3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid;

[4-Chloro-2-[[3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl] phenoxy]acetic acid;

25 [4-Chloro-2-[[3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[3-methyl-4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl] phenoxy]acetic acid;

[4-Chloro-2-[[3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;

30 [4-Chloro-2-[[3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;

c) [4-Chloro-2-[[3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]acetic acid;

- [4-Chloro-2-[[[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]acetic acid;
- [2-[(4-Benzoyl-3-methyl-1-piperazinyl)methyl]-4-chlorophenoxy]acetic acid;
- [4-chloro-2-[[2,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 5 [4-Chloro-2-[[4-(1-oxo-2-phenylpropyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-Chloro-2-[[[(3S)-3-ethyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3S)-3-ethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- (*Cis*)-[4-chloro-2-[[2,3-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 10 [4-chloro-2-[[[(3S)-4-(phenylsulfonyl)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-Chloro-2-[[[(3S)-4-(phenylacetyl)-3-propyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[[(3R,5S)-3,5-dimethyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[hexahydro-4-(phenylsulfonyl)-1*H*-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid;
- 15 acid;
- [4-chloro-2-[[hexahydro-4-[(phenylmethyl)sulfonyl]-1*H*-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid;
- [4-chloro-2-[[hexahydro-4-(phenylacetyl)-1*H*-1,4-diazepin-1-yl]methyl]phenoxy]-acetic acid;
- [4-Fluoro-2-[4-(phenyl)acetyl-1-piperazinyl]methyl]phenoxy]-acetic acid;
- 20 [4-Fluoro-2-[[4-[(phenyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- [4-Fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;
- (2*S*)-2-[4-fluoro-2-[[4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-fluoro-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-fluoro-2-[[4-[(phenylmethyl)sulfonyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 25 acid;
- [4-chloro-2-[[methyl[1-(phenylsulfonyl)-3-pyrrolidinyl]amino]methyl]phenoxy]-acetic acid;
- [4-Cyano-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid;
- [4-Methyl-2-[[[(3S)-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl]phenoxy]acetic acid;
- [2-[[[(3S)-3-Methyl-4-(phenylacetyl)-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]acetic acid;
- 30 [4-(1-methylethyl)-2-[[4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]acetic acid;
- [4-chloro-2-[[[(3S)-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(2,4-difluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl] phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(3-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

5 [4-chloro-2-[[[(3S)-4-[(3-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(2-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-

10 piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

15 [4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-3-methyl-4-[(4-methylphenyl)acetyl]-1-piperazinyl]methyl] phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-

20 piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(3-fluoro-4-methylphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[[3-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

25 [4-chloro-2-[[[(3S)-3-methyl-4-[[4-(trifluoromethoxy)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[2-(4-chlorophenyl)-2-methyl-1-oxopropyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-acetic acid;

[4-chloro-2-[[[(3S)-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-

30 acetic acid;

[2-[[[(3S)-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid;

- [2-[[*(3S)*-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]-4-(trifluoromethyl)phenoxy]-acetic acid
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(4-chlorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid;
- 5 (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(4-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-3-methyl-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-3-methyl-4-[(4-methylphenyl)acetyl]-1-
- 10 piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(4-methoxyphenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(3,4-dichlorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 15 (2*S*)-2-[4-chloro-2-[[*(3S)*-3-methyl-4-[[4-(trifluoromethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[[2-fluoro-4-(trifluoromethyl)phenyl]acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(2,4-dichlorophenyl)acetyl]-3-methyl-1-
- 20 piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-4-[(4-chloro-2-fluorophenyl)acetyl]-3-methyl-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- (2*S*)-2-[4-chloro-2-[[*(3S)*-3-methyl-4-[[4-(1-methylethyl)phenyl]acetyl]-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- 25 [2-[[*(3S)*-3-methyl-4-(phenylacetyl)-1-piperazinyl]-4-(trifluoromethyl)methyl]phenoxy]-acetic acid;
- 2-[4-chloro-2-[[*(3S)*-3-methyl-4-(phenylsulfonyl)-1-piperazinyl]methyl]phenoxy]-2-methylpropanoic acid;
- [4-chloro-2-[[*(3S)*-3-(1-methylethyl)-4-(phenylacetyl)-1-piperazinyl]methyl] phenoxy]-acetic
- 30 acid;
- (2*S*)-2-[4-chloro-2-[[3-oxo-4-(phenylmethyl)-1-piperazinyl]methyl]phenoxy]-propanoic acid;
- and pharmaceutically acceptable salts thereof.

10. A compound of formula (I) according to any one of claims 1 to 9 for use in therapy.

11. A method of treating a disease mediated by prostaglandin D<sub>2</sub>, which comprises administering to a patient a therapeutically effective amount of a compound of formula (I), or  
5 a pharmaceutically acceptable salt as defined in claims 1 to 9.

12. A method of treating a respiratory disease, such as asthma and rhinitis, in a patient suffering from, or at risk of, said disease, which comprises administering to the patient a therapeutically effective amount of a compound of formula (I), or a pharmaceutically  
10 acceptable salt or solvate thereof, as defined in claims 1 to 9.

# INTERNATIONAL SEARCH REPORT

Inte Application No  
PCT/EP2005/004464

## A. CLASSIFICATION OF SUBJECT MATTER

C07D207/48 C07C59/72 C07D333/24 C07D213/34 C07D213/56  
C07D241/08 A61K31/495 A61P11/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
C07C C07D A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, CHEM ABS Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO 2005/115382 A1 (7TM PHARMA A/S, DEN.) 8 December 2005 (2005-12-08) abstract page 80; examples d139,140 claims	1-12
A	WO 2004/089885 A1 (ASTRAZENECA AB, SWED.) 21 October 2004 (2004-10-21) abstract examples claims	1-12

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \* & \* document member of the same patent family

Date of the actual completion of the international search

24 January 2006

Date of mailing of the international search report

02/02/2006

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Stix-Malaun, E

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2005/004464

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
Although claims 11 and 12 are directed to a method of treatment of the human/animal body, the search has been carried out and based on the alleged effects of the compound/composition.
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Inte . . . Application No  
PCT/JP2005/004464

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 2005115382	A1	08-12-2005	NONE		
WO 2004089885	A1	21-10-2004	AU	2004228599 A1	21-10-2004
			CA	2521425 A1	21-10-2004
			EP	1611091 A1	04-01-2006